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OF THE

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Volume IV.

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1887.

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CALIFORNIA STATE MINING BUREAU.

HENRY G. HANKS, STATE MINERALOGIST.

FIFTH ANNUAL REPORT

OF THE

STATE MINERALOGIST,

FOR THE YEAR ENDING MAY 15, 1885.

SACRAMENTO:
STATE OFFICE...... JAMES J. AYERS, SUPT. STATE PRINTING.
1885.

To his Excellency GEORGE STONEMAN, *Governor of California:*

SIR: I have the honor herewith to submit to you the fifth annual report of the State Mineralogist of California, in compliance with section three of an Act of the Legislature, entitled "An Act to provide for the establishment and maintenance of a Mining Bureau," approved April 16, 1880.

I have the honor to be, very respectfully,

HENRY G. HANKS,
State Mineralogist.

SAN FRANCISCO, June 15, 1885.

REPORT.

The original Act creating the CALIFORNIA STATE MINING BUREAU, approved April 16, 1880, provides for an annual report by the State Mineralogist, in the following words: "At the close of each year he shall make a report in detail to the Governor, showing the amount of disbursements of the Bureau under his charge, the number of specimens collected, and giving such statistical information in reference to mines and mining as shall be deemed important." In obedience to these commands, this, the Fifth Annual Report of the State Mineralogist, has been prepared.

The prosperity of the Mining Bureau, and the growth and progress of the State Museum, since the publication of the last report, have been as remarkable as they are satisfactory. The usefulness of the institution is now more generally admitted, and the unexampled and rapid growth of the Museum is proof that the Bureau was needed and is receiving the coöperation of the people. Otherwise it would have been impossible to make so large and valuable a collection with the amount of money placed at the disposal of the State Mineralogist.

Soon after the institution of the State Mining Bureau, it became evident to the State Mineralogist that the plan upon which it was founded was radically defective, and the responsibility of the rapidly growing Bureau too much for one individual to assume. With this view, he applied repeatedly to the Legislature, asking for the appointment of a Board of Trustees who should be vested with the financial and general management, leaving him free to pursue the work for which he is best fitted. The last Legislature gave this matter their attention, and passed the following Act, which places the institution on a proper basis, and insures to the people its perpetuity and better management:

[Assembly Bill No. 78—Passed the Assembly February 11, 1885; passed the Senate March 5, 1885.]

An Act supplementary to an Act entitled "An Act to provide for the establishment and maintenance of a Mining Bureau," approved April 16, 1880.

The People of the State of California, represented in Senate and Assembly, do enact as follows:

SECTION 1. All property of this State pertaining to said Mining Bureau, and the money and financial affairs thereof, shall be vested in and be under the direction and control of a Board of Trustees of said Bureau.

SEC. 2. It shall be the duty of the Governor of the State to appoint five (5) citizens and residents of this State to be such Trustees.

SEC. 3. The appointees herein mentioned, when assembled, shall constitute the Board of Trustees of the State Mining Bureau, three of whom shall constitute a quorum. The Board shall have power, by said name, to sue and defend. They shall keep a record of all their proceedings, and they shall elect one of those so appointed to be President of the Board, and shall have the right to appoint a custodian of the Museum and other employés. The State Mineralogist shall be the director of the Museum, and shall have the right to appoint a custodian of the Museum, and other employés, subject to the approval of the Board of Trustees, and it shall be his duty to consult the Board in all matters of importance.

SEC. 4. Said Board shall make rules for its own government, for regulating the custody and disbursement of funds, and the mode of drawing the same from the State Treasury.

SEC. 5. The Board of Trustees shall, annually, report to the Governor of the State the condition of the Bureau, with a statement of the receipts and expenditures in detail, which report shall be published in the annual report of the State Mineralogist, provided for in the Act to which this is supplementary.

SEC. 6. The Trustees are hereby empowered to pay out of any moneys coming into their hands, the amount advanced by Wells, Fargo & Company, shown in the financial statement of the State Mineralogist, and published in his reports.

SEC. 7. The Board of Trustees shall be empowered to receive, on behalf of the State, bequests or gifts, legacies and devises, real estate and other property, and to use the same in accordance with the wishes of the donors; and if no instructions are given, to use their discretion for the best interests of the State Museum.

SEC. 8. The Board of Trustees may, with the assistance of the State Mineralogist, prepare a special collection of ores and minerals of California, to be sent to any World's Fair or Exposition, at which they may deem it desirable to display the mineral wealth of the State.

SEC. 9. All Acts or laws in conflict with this Act are hereby repealed.

SEC. 10. This Act shall take effect immediately.

In accordance with the provisions of the Act, the Governor appointed the following gentlemen Trustees: William Irelan, Jr., Chairman; S. Heydenfeldt, Jr., Vice-Chairman; J. Z. Davis, Walter E. Dean, and George Hearst, who accepted the office and organized April 18, 1885. Hereafter all financial matters will be managed by them, and they will report yearly to the Governor.

During the past year the State Mineralogist was informed of the intention of the owners of the building now occupied by the State Mining Bureau to reconstruct or rebuild it, necessitating, during the operation, the removal of tenants. On making inquiry and finding that such was really the intention, he felt it his duty to seek some more suitable location for the Museum and offices, in a better and more permanent building, one in which the institution would be allowed to remain for an unlimited time. Provisional arrangements were made with THE SOCIETY OF CALIFORNIA PIONEERS for the rental of a portion of their new and very elegant as well as fire-proof building, now being erected on Fourth Street, near Market, on the property donated to that society by JAMES LICK. Since the appointment of the Board of Trustees, a satisfactory and final arrangement has been made with the society, and the Museum will be removed as soon as the building is finished, which will be about the first of November. In view of the magnitude of the undertaking of moving so large an accumulation of articles demanding so much care in handling, and the time required for the rearrangement of the specimens, the Museum must remain closed for several months.

The Museum will be placed in the upper story, occupying the entire floor. This principal room will be accessible both by spacious staircases and by elevator. Of the floor below the Museum the Bureau will occupy the entire southern half. The space will be divided into five rooms: the front room will be devoted to the growing library, and the rear one will be set aside for the exclusive use of the State Mineralogist, and will serve as a private study and laboratory. The remainder of the space will be divided into three rooms: one will be used as a receiving room for boxes and new specimens, in which they will be unpacked, cleaned, and prepared; another will be used exclusively for duplicates for exchange or other disposition, and the third will be devoted to the preparation and classification of specimens for the Museum cases. It is believed that this building will provide suitable quarters for the Mining Bureau for many years to come.

VISITORS.

Daily attendance at the Museum has gradually increased; the entries on the register now number 17,841, and will probably be increased to 20,000 before removal. A new register will be commenced in the new building. The number of names entered does not fully indicate the total attendance, for many persons do not register without being invited to do

so, and in many instances decline to enter their names on a second visit. A plan will be pursued in the new rooms to indicate the actual number of persons who visit the Museum, independent of the entry of names.

CHEMICAL WORK.

Owing to the want of a suitable laboratory, and of the means to employ an assistant chemist, the State Mineralogist has been compelled to decline for the present making analyses of new minerals, ores, etc., to do which would afford him great satisfaction. Such laboratory work has long been contemplated by him. There could scarcely be a more important work than this. The results would not only be of the greatest interest to those applying for information, but on being published in the reports of this office, the results would not alone be valuable to the miners of California, but interesting and instructive to others, in other States and countries.

This department is so important that it should be duly considered by the Legislature, and a sufficient appropriation made to equip a suitable chemical and metallurgical laboratory, and to employ an assistant chemist.

An attempt was made by the last Legislature to transfer this work to the State University, which has an admirable and well appointed laboratory, a professor in charge, and advanced students to whom the work could be intrusted. A bill was passed creating the office of State Analyst in which the following section was inserted: "Sec. 6. It shall be competent for the Mineralogist of the State of California to submit to the State Analyst any minerals of which he desires an analysis to be made, provided that the cost of the same shall be defrayed by the Mining Bureau." But as no provision was made to pay the special chemist whom it was proposed to employ to superintend the work of the Mining Bureau, and as the condition of the funds of that institution would not admit of such disbursement, the Act, as far as the State Mining Bureau is concerned, remains inoperative.

Many minerals and mineral products are daily sent to the State Mineralogist for examination. This work is done as expeditiously as possible, and the required information sent. But this class of work has increased to such an extent that it would require the whole time of one person to do it properly. For this reason it is impossible for the State Mineralogist to do it all without neglecting his other duties. This unavoidable delay very naturally causes dissatisfaction, and letters of complaint are frequently received. Still, until more assistance can be employed, it cannot be avoided, much as it may be regretted.

CORRESPONDENCE.

This department, also, is growing daily in magnitude, and is now quite sufficient to employ the entire time of one individual during the business hours of the institution. Like the chemical work, and for the same reason, it sometimes so accumulates that letters remain too long unanswered. It would be a source of satisfaction to the State Mineralogist if all letters could be replied to immediately on receipt, but this cannot always be. To explain and to offer an apology to writers, the following circulars have been prepared and are inclosed with replies, which are sometimes necessarily brief:

CIRCULAR.

California State Mining Bureau, Office of State Mineralogist,
San Francisco, ________________, 188__.

The Act creating the State Mining Bureau, for the advancement of legitimate mining in California, provides for the collection and display, in a State Museum at San Francisco, of the varied mineral products of California—the collection to include not only the precious metals, but all minerals which have an economic value and can be used in the arts, in manufactures, in agriculture, or in commerce.

It is the province of the State Mining Bureau to give general information relating to the mineral interests of the State, to aid in which correspondence is solicited; information, however obtained, will be placed on record in the office of the Mining Bureau for the use and benefit of all interested. It will be the aim of the Bureau, through the agency of the State Museum and by its publications, to call the attention of the world to the natural advantages of California as a desirable place of residence, and as a field for the profitable investment of capital. To secure this end, the coöperation of all those who have the interest of the State at heart, is much to be desired. Information, therefore, bearing on the general interest of the commonwealth, will be thankfully received.

This circular is specially prepared to assist in answering certain questions frequently asked in letters received by the Mining Bureau, and to avoid the constant repetition in replies. Certain information is so frequently asked, that it can be better given in a carefully prepared circular than by the pen.

The correspondence of the Bureau has increased to such an extent that it is impossible to answer all letters in detail without some plan to save labor, and it is often impossible to answer immediately, for the following reasons:

First—All letters must take their turn.

Second—The information asked cannot always be obtained without delay, and specimens sent with letters do not in every case reach the Bureau at the same time. Frequently, specimens require careful examination, in which they must take their turn.

Third—Sometimes the State Mineralogist is out of the city, and all specimens requiring his special attention must await his return.

For the above reasons, neither delay nor extreme brevity in correspondence should be mistaken for neglect.

Ores are frequently sent to the State Mining Bureau to be assayed for gold, silver, lead, copper, tin, etc.; the Bureau does not make commercial assays, for the reason that such a course would interfere with the business of assayers, which was not the intention of the framers of the Act.

While the Mining Bureau cannot, for the above reason, agree to furnish assays, it will determine minerals, and will make analyses of any new mineral discovery, the publication of which would be of interest to the citizens of the State generally.

All iron ores, mineral waters, building stones, marbles, limestones, coal, coal oil, asphaltum, and other useful minerals, will be analyzed or examined, and the result published. This will be done for a double purpose: first, to give the world a reliable account of what the State produces; and to encourage others to search for valuable minerals. All information given by the Bureau, and all work done, will be free.

The State Mining Bureau does not take any interest in mining property, in the sense of negotiating sales or furnishing capital.

When specimens of valuable minerals are received they are carefully labeled and placed in cases in the Museum, where they can be seen and examined by all. When inquiry is made for certain minerals found in the State, the persons making such inquiry are shown the case containing minerals of that class, and all information given.

The Mining Bureau does not deal in mining stocks, nor will it give any quotations or advice as to their purchase or sale, but will at all times give such information as it may possess concerning the mines themselves.

It is desired to make the ethnology of the Pacific Coast a feature of the Museum. All Indian relics, recent or prehistoric, will find a place, and their collection will no doubt throw much light on the ancient history of the State.

Every article sent to the Bureau will become the property of the State, for the use and benefit of the public, and will be carefully preserved in the State Museum.

All packages should be addressed to the California State Mining Bureau, San Francisco, and sent by Wells, Fargo & Co.'s Express, or by railroad or steamship lines as slow freight.

HENRY G. HANKS, State Mineralogist.

California State Mining Bureau, Office of State Mineralogist,
San Francisco________________, 188__.

Mr. —— ——, ——:

Dear Sir: The specimens mentioned in your letter dated ——, were not received, or were not marked in such a manner that they could be recognized as those described in your letter.

This frequently occurs, and causes disappointment to those sending to the State Mining

Bureau for information. No appropriate answer can be returned until the specimens are received and examined, for which reason letters of this character are laid aside for an indefinite period, as in this case.

All packages should be plainly marked, *on the inside*, with the name of sender, locality, etc., as no dependence can be placed on post-marks, which are generally illegible.

Asking you to excuse delay, I remain very truly,

——— ———,
State Mineralogist.

LIBRARY.

The library so far has been comparatively so insignificant that no special attention has been given to it beyond that required for the care of the books, but in the new quarters a special room will be devoted to this very important branch of the State Mining Bureau.

While the number of books is not as yet very large, they are specially valuable, and already the library is an important one of reference. Every effort in the future will be made to increase the number of books, and it is to be hoped that public spirited citizens, of whom there are many in the State, will aid this department by gifts of books, as miners have almost wholly created the Museum by their donations. This is a matter for the consideration of our best citizens.

By the order of the Board of Trustees, the State Mineralogist purchased in New Orleans a number of rare and valuable works on mining and kindred subjects, which constitute an important addition to the library.

The following newspapers continue to be sent to the Mining Bureau gratuitously:

1. Engineering and Mining Journal, New York.
2. Mining Record, New York.
3. Mining Review, Chicago, Illinois.
4. Economist, Boston, Massachusetts.
5. Daily Report, San Francisco, California.
6. Daily Grass Valley Union, Nevada County, California.
7. Daily Evening Gazette, Reno, Nevada.
8. Sierra County Tribune, California.
9. Humboldt Standard, Eureka, Humboldt County, California.
10. Inyo Independent, Inyo County, California.
11. Arizona Gazette, Phœnix, Arizona Territory.
12. Ventura Free Press, San Buenaventura, California.

PUBLICATIONS.

All the publications of the Mining Bureau have been distributed. There has been an unusual demand for them. No partiality has been shown in their distribution. As long as any remained, all applications were honored, if the person asking had not already received a copy. Many applications from the State, from the East, and from foreign countries, have been received since the reports were exhausted. There is no law providing for the reprinting of the publications of the State Mining Bureau, but it would seem that reports made in the interest of the State should be supplied as long as the demand continues.

CATALOGUES.

A second volume of the Museum Catalogue has been printed during the last year. This brings the number of entered specimens to 6,000. A third volume has been commenced, of which 488 numbers have been sent to the State Printer. There are a large number of valuable specimens in the rooms which have never been entered in the catalogue or prepared for the Museum. When they are so prepared and placed in cases, they will aug-

ment very considerably the already extensive State collection, and add materially to the exhibit.

A catalogue of the books in the library has also been printed, which was alluded to in the last report. There were at the date of the catalogue, May 15, 1884, of printed books, 247; of maps, lithographs, etc., 156; total, 403. Besides these, there were a very large number of pamphlets and publications of scientific societies sent to the Mining Bureau as donations or in exchange for the reports of the Mining Bureau. Since the publication of the library catalogue many more books and pamphlets have been received.

GENERAL MUSEUM.

It is to be hoped that citizens will now more generally avail themselves of the opportunity afforded by the State Museum to gain a knowledge of the resources of their State, and will not only visit the Museum themselves but will encourage their children to do so. Strangers do not need this invitation, as they constitute the most frequent visitors. It is a severe reflection on our citizens to state the truth—that but few in proportion know of the existence of the State Museum, much less do they visit it.

DONATIONS AND ACCESSIONS TO THE MUSEUM

Have been large during the last year, and some of them are very valuable. It has been the custom in former reports to give the names of donors. This is omitted in this, owing to delay in preparation, caused by the absence of the State Mineralogist from his office, during the New Orleans Exposition. Due credit will, however, be given in the next.

RECEIPTS AND DISBURSEMENTS, STATE MINING BUREAU, FROM MAY 15, 1884, TO MAY 15, 1885.

RECEIPTS.

Cash on hand as per last report	$81 22
Bureau Fund	4,737 60
Warrants for State Mineralogist's salary	3,000 00
	$7,818 82

DISBURSEMENTS.

General expenses		$576 96	
Rent		2,400 00	
		$2,976 96	
Salaries—Janitor	$820 00		
Compilers and writers	148 00		
Museum attendance	268 00		
Accountant	170 00		
State Mineralogist	3,000 00		
		4,406 00	
Postage		82 60	
Museum		181 60	
Maps		10 00	
Library		18 25	
Traveling expenses		130 60	
Cash on hand		12 81	
			$7,818 82

THE NEW ORLEANS EXPOSITION.

During the past year an International Exposition was held in the City of New Orleans. Commissioners were appointed by the respective State Governments, including California. When it was proposed to send the State collection of minerals, the same controversy arose as before the Denver

Exposition of 1882, and with the same result. It was decided that the State Mineralogist had no authority to remove the minerals from the City of San Francisco. In this dilemma, it being the popular wish that the mineral as well as the agricultural, commercial, and manufacturing interests of the State should be represented, an appeal was made to the Legislature (then in session) which resulted in the passage of the following concurrent resolution:

Assembly Concurrent Resolution No. 11, relative to sending the mineral collection of the State Mining Bureau to the World's Fair and Cotton Centennial Exposition at New Orleans:

Resolved by the Assembly, the Senate concurring, That the State Mineralogist be and is hereby authorized and directed to carefully pack and ship to New Orleans, so much of the cabinet of minerals now in the State Mining Bureau, at San Francisco, as will secure a proper representation of the mineral wealth and resources of California in the World's Industrial and Cotton Centennial Exposition, now open in New Orleans; said exhibit to be under the charge and control of the State Mineralogist; and at the close of the Exposition, or sooner if by him deemed expedient or proper, to be returned to its present quarters in the State Mining Bureau. The expense attending this exhibit shall be paid out of any appropriation made by this Legislature for the better display of the resources of the State of California, at such Exposition.

Immediately on receiving a certified copy of the resolution from the Secretary of State, the Museum was temporarily closed, and all the California minerals and ores packed with the greatest expedition and care, all of which was completed and the cases were ready on February twenty-fifth, but shipment was delayed until March third. On that day the State Mineralogist left San Francisco for New Orleans, where he arrived Sunday, March eighth. On March fourteenth the minerals arrived in New Orleans, but it was not until the eighteenth of the month that they were delivered at the Government Building of the Exposition. On the twentieth day of March the beautiful onyx marble mantel, which was loaned to the Mining Bureau by Mr. J. Z. Davis of San Francisco, was set up in the California headquarters. April first all the cases were in order and the arrangement of the entire collection complete.

There were twenty-five plate-glass cases brought from the State Museum; the rough boxes in which they were packed were piled in such a way as to furnish improvised tables, which were neatly covered with dark colored cloth. On these, large piles of rough ores, petroleum, borax, salt, asphaltum, silicified wood, manufactured iron, quicksilver, etc., were placed, the whole presenting an attractive appearance. The collection remained undisturbed until the end of the Exposition, when it was repacked, and on the sixth of June was placed in a car and delivered to the railroad company, to be returned to San Francisco. The State Mineralogist arrived on the thirteenth of June, but the minerals and cases were not returned to the State Museum until July second. A number of the cases were damaged, and several of the glass plates broken. As the Museum is about to be removed, as elsewhere stated, it was thought best not to unpack the minerals until possession was taken of the new quarters; until which time the damage to the minerals, if any, cannot be known. The injury to the cases cannot be repaired without an outlay of one hundred and six dollars, as estimated by the cabinet-maker.

On consultation with the Governor, he granted permission to make a full and detailed report on the mineral exhibit of California, to be supplemented by a more general one of the mineral exhibits of all the States and Territories shown in the Government Building. To carry out this plan, and in accordance with a previous understanding with prominent citizens, the State Mineralogist left New Orleans some time after the minerals were

arranged, and spent seventeen days in visiting gold mines in Georgia and North Carolina, and some of the iron and coal mines in Alabama and Tennessee, an account of which will appear in the general report to follow this.

In making the proposed report, all exhibits other than mineral must of necessity be ignored. While some States do not appear to advantage as mineral producers, it must not for that reason be thought that they were not well represented otherwise. In many instances States showing but few even of the minerals to be found within their boundaries, made magnificent displays of agricultural and other resources. In the vastness of the building, some mineral exhibits may have been overlooked. The report will describe those actually seen and examined.

California was well represented in every department. It was the only time the State has ever asserted herself at a World's Fair, and there can be no doubt that the effect of the Exposition will long operate to her advantage. One of the most remarkable and striking features of the Exposition was the gathering under one roof in the Government Building, from all parts of the American Union, not only the natural resources of the various States and Territories, but also many representative men and women. Not only were mechanics of the highest order numbered among the visitors, but also scientific and literary men, whose writings have made their names widely known to the world, and men of rare business ability, skilled in the employment of large sums of money.

Contrary to expectation, the Exposition failed to be in a general sense international, but became more a display of American inventions and native wealth. While the Main Building was a marvel of size, and was no doubt the largest collection of manufactures and resources ever gathered together in one building, the chief interest of the Exposition was centered in the Government Building, in praise of which too much cannot be said or written. Under this single roof were placed side by side the natural resources of the several States and Territories, so abundant and so varied in character as to cause a feeling of pride in the breast of every American citizen who saw them; while to the foreigner it was a lesson he was quick to observe. It was clearly shown on the one hand that the United States have within their borders vast stores of raw material, vegetable, animal, and mineral; and on the other that American citizens and mechanics have the ability and the energy to manufacture them to an extent far beyond the requirements of the nation; so that if cut off for any reason from intercourse with other countries, the people have ample material and the ability and the inclination to supply their wants from their own resources.

It was interesting to note the composite character of the National and State exhibits; what one is deficient in, another supplies in the greatest abundance. The contributions from the several States were so large, so comprehensive, and so generous, that no general comparison can be made between them. All were beyond what could be expected of them, when all the difficulties attending their collection are considered.

The collective exhibit afforded a rare opportunity for study and consideration on the part of the political economist, the technologist, the capitalist, the student, and the lover of pure science. Here men of science and intelligence met to exchange ideas, to give and to receive information, and presumably to prepare for publication the results of their observations.

One feature of the Exposition should be mentioned here, although not to the credit of all the States, a number of which were represented by individuals, some of whom could but ill afford to bear the expense, while the States they so well represented were benefited and tacitly accepted the honor. These self-denying persons were in too many instances compelled

to sell goods to pay their expenses, or to endure actual want. Many were placed in this position, and inconvenience if not actual suffering was quite too common. Some States were wholly, others in part, represented by railroad companies, which expended large sums of money to assist the Exposition, receiving back only a portion of the disbursement in fares and transportation. No instance came to my knowledge in which a railroad company, in advancing its own interest, attempted to eclipse or ignore actual State exhibits. Every State and Territory in the Union was represented except *Utah* and *Alaska*, yet only a portion made appropriations or officially recognized the Exposition beyond the appointment of a Commissioner. Still the World's Fair was a great national success in every sense except financially.

Outside of the direct and practical benefit resulting from the Exposition, it did much to create a good feeling between the North and the South, in which sense it was worth more to the nation than the entire cost. Thrown together for months, people from both sections came to know more of each other. Northern and Western visitors were met with a cordiality, both in the City of New Orleans and throughout the entire South, as gratifying as it was in many cases unexpected.

HISTORY OF FORMER WORLD'S FAIRS OR INTERNATIONAL EXPOSITIONS, COMPILED FROM VARIOUS SOURCES.

The first International Exposition or World's Fair was held in Hyde Park, in London, England, in the year 1851. The Society of Arts of England had been accustomed to hold annual fairs for many years. In 1849 the Council of that society recommended that the exhibition of 1851 should be the first of a series "which should culminate every fifth year in a great National Fair, or Exposition, embracing all manufactures." Application was made by the society to the British Government, asking the Government to provide a permanent building for such exhibits. His Royal Highness, Prince Albert, was at that time President of the society, and suggested that the proposed national display should be made *international*. The reply from the Home Secretary to a letter from the Prince being favorable, the society commenced active operations. In 1850, the Queen issued a royal commission providing for an inquiry as to the best methods to insure success. It was thought best at first to provide funds by private subscription, but it was found to be impossible to collect sufficient money by this plan, and in June a guarantee fund of $1,000,000 was proposed. A royal charter was obtained, and the Commission borrowed money from the Bank of England to make up the deficit.

In 1850 architects were asked to send in plans, to which request two hundred and thirty-three responses were received. The plan drawn by Sir Joseph Paxton was accepted, which proposed a building wholly of iron and glass. The building was commenced in September, 1850, and finished at the opening, May 1, 1851. The working time was about one hundred and ninety days. The building was three stories high, and had the following dimensions: Length, 1,840 feet; width, 408 feet; area of ground floor, 772,784 square feet; area of galleries, 217,100 square feet; total area, 989,884 square feet—about $28\frac{6}{10}$ acres. The central dome was 104 feet high. The contract price was $388,350, with the understanding that the proceeds of the sale of the building after the Exposition should be paid to

the contractors. But there was so much extra work ordered by the management that the price finally awarded was $694,810; the building sold for $365,018, so that the total amount received by the contractors was $1,059,828. The Exposition opened May 1, 1851, and closed October fifteenth. Her Majesty the Queen presided in person at the opening.

Days open		141
Total daily paid admissions		5,265,429
Total admissions		6,039,195
Season tickets issued		773,766
Average daily attendance		42,831
Largest attendance (October 7)		109,915
Largest number in the building at one time (October 7)		93,224
Smallest daily admissions		9,327
Exhibitors (foreign)	6,556	
Exhibitors (Great Britain)	7,382	
Total number of exhibitors		13,938

Total receipts	£506,100 06 11
Total expenditures	292,794 11 03
Surplus	£213,305 15 08
About	$1,032,400 00

The building was sold in 1852 to the Crystal Palace Company, by whom it was taken down and rebuilt at Sydenham, a London suburb, where it was surrounded with gardens and transformed into a public pleasure resort.

DUBLIN—1853.

The Royal Society of Dublin, Ireland, had made triennial exhibitions since the year 1835. When in 1852 it was proposed to hold the usual fair in 1853, the society received from a contractor, Mr. William Dargan, an offer to furnish a building under the following conditions: The contractor proposed to advance $97,000 for the construction of an Exposition building which should revert to him at the close. He was to receive all the net proceeds under the specified sum, with five per cent interest added; the valuation of the building to be taken as part of the money to be paid him. The offer was accepted and plans for the building solicited. The award was made to Sir John Benson of Cork, and the building erected under his supervision. The edifice was two stories high, and constructed principally of timber; the skylights were of corrugated glass; superficial area about 265,000 square feet, or over six acres. The building was commenced August, 1852. The Exposition opened May 12, 1853. The building consisted of five parallel arched and dome-roofed halls. The central hall was 425 feet long, and 100 feet wide, and 105 feet high. The northern and southern halls each 375 feet long, 50 feet wide, and 65 feet high. Hall for fine arts 325 feet long, 40 feet wide, and 38 feet high. Machinery hall 450 feet long, 40 feet wide, and 46 feet high. The building cost more than was anticipated—$290,000, and when sold at the termination of the Exposition, brought only $77,000. While it was being erected, the Executive Committee decided to make the Exposition international. There were no premiums or awards offered.

The receipts for admission were about $229,000, and the attendance was about 1,000,000.

EXPOSITION OF THE INDUSTRY OF ALL NATIONS, NEW YORK—1853-4.

An association of prominent citizens of the United States was formed in the latter part of 1851 for the purpose of planning an American Interna-

tional Exposition of the Industry of all Nations. In 1852 the City Government of New York gave the association free use for five years of Reservoir Square, bounded by Fortieth Street, Sixth Avenue, Forty-second Street, and the Croton Reservoir, on condition that a building of iron and glass should be erected, and the price of a single admission should not exceed fifty cents.

The Association for the Exhibition of the Industries of all Nations was incorporated March 11, 1852, with a capital stock of $500,000, and a term of five years. The admittance to the Exposition was set at fifty cents. It was provided that on one day all children of charitable institutions and public schools should be admitted free. It was provided, also, in the charter granted by the Legislature of New York, that the net proceeds of one day's exhibition should be devoted to the relief fund of the Fire Department of the City of New York. The United States Government did not officially indorse the association, but made the building a bonded warehouse for the convenience of foreign exhibitors. The Exposition was, in reality, a private business enterprise, although patronized and assisted by the General Government.

The association invited architects to send in plans for an Exposition building; a number were presented, and those of Carstensen & Gildmeister were selected as the most suitable. The building was commenced in October, 1852, and was only partially finished, after several postponements, at the opening, which took place on July 14, 1853. Its form was that of a Greek cross surmounted by a central dome one hundred feet in diameter. The dimensions were:

Length of naves	149 feet.
Width of naves	41½ feet.
Width of aisles	54 feet.
The length of each diameter of the building along the main aisles was	365 feet 5 inches.
Area of principal floor	157,195 sq. feet.
Area of second floor	92,496 sq. feet.
Total area of building	249,691 sq. feet.
Or about	5¾ acres.

The square space, nearly all of which was occupied by the building, was 445 by 455 feet. The framework was of iron, with a large area of glass. The whole quantity of iron used in the construction of the building was 1,800 tons, of which 1,500 tons were cast iron and 300 tons wrought iron. Of glass, the quantity was 15,000 panes, or 55,000 square feet. 750,000 feet, board measure, of boards and timbers were also used. The general effect of the building, externally and internally, was graceful, light, striking, and beautiful. There was an octagonal space in the gallery or upper floor under the dome, and an arched cross reaching to the roof and extending from each of the four main entrances to the center. The staircases were of iron, and beautifully curved. The roof and dome were painted and decorated, and the whole exterior and interior painted in oil colors. The outside was finished in light bronze color, and the ornamental portions partly gilded. The general color of the interior was buff or cream color, relieved by red, blue, and yellow, applied skillfully and only in quantities sufficient to produce an artistic effect. A portion of the ornamental work was gilded.

The Exposition was opened July 14, 1853, by President Pierce in person, and thrown open to the public on the following day.

PARIS—1855.

France began holding exhibitions or fairs in 1798. On the occasion of the eleventh, in 1849, Napoleon, then President, proposed an international exhibit, in which all countries should be invited to participate, but the proposal did not meet the approval of the French people. When the first English Exposition based on the same idea met with such marked success, the French were ready to do likewise, and it was decided that the next Exposition to be held in France, in 1855, should be made international, and in 1852 the Emperor directed the building of a permanent structure in the *Champs Elysées*, the principal avenue in the City of Paris, "to receive national exhibitions and to serve for great public ceremonies and for civil and military fétes."

A company was organized to construct an Exposition building, for which they were to be repaid by a thirty-five years' lease of the site and the profit from the exhibition. The accepted plans for the building were made by Viel and Desjardins. The contract was awarded to York et Cie, with the privilege to make changes in the plan, provided they neither altered the dimensions, the solidity, nor the artistic aspect of the building, which was to be considered as a national monument.

The building was 827 feet long by 354 feet wide, in form a parallelogram. To this principal building was added an Annex, a Palace of Fine Arts, a building containing a panorama of the Champs Elysées, connected with the main building by an arched passage. The area of the several parts of the Exposition was as follows:

Industrial Palace (square feet)	545,934
Annexes	446,955
Panorama and passage	97,116
Palace of Fine Arts	173,768
Gardens and inclosed grounds	237,648
Total area (square feet)	1,501,421

Or over 34 acres. Of this more than one million and a quarter square feet were covered.

There were exhibitors	20,780
Total admissions	5,162,330
Average daily admissions	25,811
Largest attendance one day	123,017
Total expenses, about	$2,201,000 00
Receipts, about	574,000 00
Cost of Industrial Palace	2,524,000 00
Cost of Annexes	777,000 00
Cost of Panorama	194,000 00
	$3,495,000 00

This Exposition opened May 15, 1855, and closed on November fifteenth of the same year. The French Government was wise enough to consider the advantage such an exhibit would be to the nation in many ways, without considering or expecting a direct return from the proceeds of the admission fees. And so satisfactory were the results that the Government, with the approval and sanction of the people, has thrice repeated the Exposition, each time on a grander scale, and is now planning one which is expected to far excel those of the past.

LONDON EXPOSITION—1862.

The success of the first international exposition in London, in 1851, was a source of great satisfaction to the people of England, so much so that

there was strong inclination manifested to repeat it on a grander scale. This desire culminated in 1862.

As at the first Exposition the first active steps were taken by the Society of Arts. The first Commission had used the surplus derived from the Exposition of 1851 to purchase a considerable tract of land in Kensington, a suburb of London, a portion of which they had leased to the Royal Horticultural Society.

In March, 1860, the Society of Arts applied to the Commission, asking for the use of these grounds for an international Exposition, to be held in 1862, provided the society could obtain sufficient funds, by subscription, to meet the expenses. A favorable decision being returned, the society made a public call for subscriptions to the amount of $1,120,000 as a guarantee fund. In June, the required sum having been subscribed, it was thought best to increase it to $2,174,595.

The terms of the agreement made with the Commission were as follows: They engaged to lease the required ground free of rent for the Exposition, at the termination of which all temporary buildings were to be removed. If the profits of the Exposition would allow of the erection of a permanent building at a cost not to exceed $243,000, they would on the receipt of $48,665 lease the lands to the society for ninety-nine years without further cost.

The Queen appointed five Commissioners, at the request of the society, and the Bank of England agreed to advance the necessary funds when all the signatures to the guarantee deed were obtained.

The plans of Captain Francis Fowkes, of the Royal Engineers, being accepted, contracts for the building were let at an estimated cost of $2,092,595. The contractors agreed to complete the building by February 12, 1862, to remove the same after the Exposition was ended, and to receive $973,300 if the profits were less than $1,946,600. If the profits reached that sum, or were in excess, they were to receive $1,459,950, and the Commissioners were privileged to purchase the building for $2,092,595 in lieu of rent or other payment.

The building was commenced March 7, 1861, and finished in April, 1862. It was built principally of brick and iron; the main portion $1,150\frac{3}{4}$ feet long by 500 wide, and two stories high. The two wings were each 750 feet long by 250 wide. There were towers at the ends of the main building and wings. 7,000,000 bricks, 12,000 tons of wrought iron, and 4,000 tons of cast iron were used in the construction. There were 820 columns of iron, 25 feet long, equal to four miles in length; and 1,266 iron girders, the combined length of which equaled six miles. 1,000,000 superficial feet of lumber was required and used for floors; and 486,380 square feet of felt was used on the roof, equal to eleven acres. 353,000 superficial feet of glass was used, equal to over eight acres, the weight of which was 247 tons. The building was substantial and ornamental, both outside and inside. There were two twelve-sided domes of glass, with an outer and inner gallery to each. They were 160 feet in diameter, and 250 feet high. The interior of the building was beautifully painted and decorated, and the remarkable feat of finishing twenty acres of surface in eight weeks was performed. The principal color was a warm pale gray, with panels of blue and red, relieved by colored lines and circles of black, with stars or rosettes of gold. The iron columns were painted bronze color, relieved with gold color. The capitals were gilt, and ornamental parts picked in with rich red and blue, alternately. The center blocks of the columns were colored red, with bands of blue, or *vice versa*, and gilt moldings. The interior of

the dome was also richly decorated in gold, blue, red, green, and maroon. The colors were selected with taste and applied with skill, by an artist of well known ability and judgment. In suitable positions there were inscriptions and quotations in letters of gold.

The Exposition was opened May 1, 1862. The Duke of Cambridge, representing the Queen, was assisted by Earl Granville in the ceremonies. The exhibition remained open one hundred and seventy-one days.

The total admissions were	6,211,130
Average daily admissions	36,328
Largest admissions for a single day	67,891
Smallest admissions for a single day	5,615
Total receipts from admissions	$1,977,285

At this Exposition, minerals in the crude state and manufactured were made a special feature. The success was not equal to that of 1851. It was almost a failure financially, and its general failure was attributed partly to the war in the United States, partly to mismanagement, and especially to the great frequency of such exhibits elsewhere. It was judged, from the experience on this occasion, that at least twenty-five years should intervene in any one country between international expositions.

PARIS UNIVERSAL EXPOSITION OF 1867.

This Exposition was created by a decree of the French Emperor. The site chosen was the *Champ de Mars*, the parade ground of the *Ecole Militaire*. The grounds were rectangular, and had an area of 119 acres. The building was circular, or rather was in form that of a rectangle with rounded ends, and was in effect seven concentric galleries inclosing a central pavilion surmounted by a dome. The area of the building was thirty-nine acres. Through the center of the grounds and building, from *Pont d' Jena* to the *Ecole Militaire*, ran the wide *Avenue de Europe*. The whole space not occupied by the building was laid out into a beautiful garden with serpentine walks. M. Le Play was appointed general manager. The building was commenced April 3, 1866, and finished by the end of the year. It was formally opened by the Emperor on April first and closed October thirty-first of the same year. Funds for this Exposition were obtained as follows:

From the Imperial Government	$1,165,020
Appropriation—City of Paris	1,165,020
Public subscription, about	2,000,000
Guarantee fund	1,553,360
Total	$5,883,400

Number of days open	214
Total admissions	8,706,037
Average daily attendance	43,561
Largest number of visitors in one day	184,405
Smallest number of visitors in one day	1,002

The total receipts for admissions were 10,765,000 francs; sale of tickets, 8,407,209 francs. When a settlement was made a deficiency was announced of 10,000,000 francs, as shown in the published reports of the Government.

Each gallery was devoted to a special class of exhibits. This I believe was the first instance in which California was officially represented at any international Exposition. Professor William P. Blake was appointed State Commissioner to represent California, which he did to the credit of him-

self and the State. He made a collection of ores, minerals, and characteristic products, in all about 300 specimens. Gold, silver, copper, lead, iron, quicksilver, borax, salt, petroleum, and building materials were shown. A full list of the specimens was published in the *Mining and Scientific Press*, March 23, 1867, vol. 16, folio 178.

Dr. J. B. Pigné, of San Francisco, exhibited a special collection of ores and minerals from the Pacific Coast, including California. These specimens were selected for their beauty and richness in the minerals they represented. At the termination, they were donated to the *Ecole Imperiale des Mines* of Paris. Besides the mineral display, the following names of California exhibitors appear in the reports:

Books.—State Agricultural Society, by reports and transactions.

Cereals.—A collective exhibit of California cereals was made by J. W. H. Campbell of San Francisco, J. D. Peters of Stockton, and L. D. Perkins of Oakland.

A special sack of high mixed white wheat, weighing one hundred and twenty pounds, was shown by Mr. Campbell, which attracted much attention and was solicited for seed. At the close, what remained was donated to the Royal Agricultural Society of England. A special collection of seeds of cereals and vegetables, one hundred and twenty varieties in all, was exhibited by Mr. Perkins, all of which were donated at the close to the Imperial *Societé de Acclimation* of France.

Glassware, by the Pacific Glass Works, of San Francisco, a large variety.

Hops.—T. Scheer, of San Francisco, exhibited a bale of hops of excellent quality, which was distributed to those interested, in small samples.

Life Boat Model, by J. Reed, of San Francisco.

Paper.—San Lorenzo Paper Mills.

Pump—Steam Wrecking—by Harrison & Co., of San Francisco. This, discharging, as it did constantly, a large volume of water, was a conspicuous object in the Exposition.

Photographs.—C. E. Watkins made a fine exhibit of California views, consisting of a complete set (30) of Yosemite views, and views of the big trees of the Mariposa Grove. These views were mounted in frames of the wood they represented.

Lawrence & Houseworth exhibited photographic and stereoscopic views, twenty-two large views of the Yosemite Valley, four of the Big Trees, twenty-one stereoscopic views of the Yosemite Valley, thirty-three of the Mammoth Trees, forty of San Francisco, seventeen illustrating hydraulic mining, forty-three of placer mining, and one hundred and fifty-eight of California scenes.

Edward Vischer, of San Francisco, sent six photographic albums of California and Nevada, which did not reach the Exposition.

Saw Teeth, adjustable for circular saws. Exhibited by W. P. Miller, of San Francisco.

Soap and Washing Powders.—Exhibited by the Standard Soap Company. The following absurd statement appears in the official reports: "The alkali is said to be made from the ashes of the ice plant, which grows in Santa Barbara County."

Wines.—Buena Vista Vinicultural Society of San Francisco exhibited sparkling Sonoma wines.

C. H. Le Franc, of New Almaden, Santa Clara County, red and white wines.

M. Keller, Rising Sun and Los Angeles vineyards, brandy, wine, and bitters.

Kohler & Frohling, San Francisco, Los Angeles red and white wines.

Sansevain Brothers, Los Angeles, wines.

Wire Rope.—A. S. Hallidie exhibited round and flat wire rope. The entire exhibit was donated to the *Conservatoire des Arts et Metiers*, at the close of the Exposition.

Woods.—John D. Boyd, of San Francisco, made a fine display of California woods and veneers, and two doors varnished and highly polished—one of redwood and one of laurel.

Woolen Goods.—Mission Woolen Mills, San Francisco, showed a large assortment of blankets, traveling shawls, cassimeres, and flannels. They were mixed, plaid, and plain, and the blankets were both colored and plain. The peculiar blanket used to collect gold and sulphurets in the sluices was shown and attracted the attention of mining men.

The following Californian exhibitors received awards:

W. P. Blake, Commissioner, silver medal, for exhibit of California minerals. This is equivalent to an award to the State.

State of California, for cereals, also a silver medal.

Dr. J. B. Pigné. Silver medal.

Mission Woolen Mills, for woolen fabrics, bronze medal.

C. E. Watkins, photographs, bronze medal.

Buena Vista Agricultural Society. Honorable mention.

The following States and Territories were represented by mineral exhibits, some by large State exhibits, others by a few specimens, sometimes shown by private individuals:

Alabama,	Iowa,	New Mexico,
Arizona,	Kansas,	Nevada,
Arkansas,	Louisiana,	Ohio,
California,	Maryland,	Oregon,
Colorado,	Massachusetts,	Pennsylvania,
Connecticut,	Michigan,	Utah,
Dakota,	Minnesota,	Vermont,
Georgia,	Missouri,	Washington,
Idaho,	Montana,	West Virginia,
Illinois,	New Jersey,	Wisconsin.

VIENNA INTERNATIONAL EXHIBITION—1873.

The Austro-Hungarian Government announced to the Government of the United States its intention to hold an international exhibition in the City of Vienna in the year 1873, by an official letter from Baron Lederer, then Austrian Minister to the United States, to the Secretary of State. This letter was dated June 29, 1870. Baron Lederer asked that the facts be brought to the notice of the proper authorities of the United States.

In due time, by an Act of Congress, passed in June, 1872, the President was authorized to appoint one or more persons to represent the United States at the Exposition, and by joint resolution an appropriation was made of $300,000 to carry out that purpose.

The Exposition was held in the Prater, the great public park of Vienna. It was opened on the first of May, 1873, and closed October thirty-first, of the same year—one hundred and eighty-six days. The park is convenient to the central part of the city and can be reached by walking within thirty minutes.

The main exhibition was held in a single building of great size and of peculiar construction, besides which there were, as usual, a series of annexes, consisting mainly of a large machinery hall, detached from the great building to avoid noise, and smell of oil and smoke.

The main building, the "Industrial Palace," consisted of a central nave

2,953 feet long by 84 feet wide and 74 feet high, with a grand central rotunda 358 feet in diameter and 80 feet high—the largest ever built in the world. Along the line of the building there were sixteen cross transepts, each 572 feet long by 51 feet wide, forming an immense "gridiron," as the building was whimsically called. The buildings were principally wood and quite temporary in character. Brick, iron, and stucco of cement and sand were also largely used in part in the construction. Considerable taste was shown in painting the interior, the principal colors being creamy gray and bronze colors relieved with gilding. The total area of the main building was 1,833,000 square feet, and the machinery hall had an area of 429,000 square feet.

Thirty-one foreign countries made exhibits. The United States was not well represented, and there was much dissatisfaction expressed. The United States Government appointed seven scientific Commissioners, eighty-eight honorary, and eight skilled and practical citizens. The Commissioner-General was H. Garretson. The total number of United States exhibits were six hundred and forty-three, of which California made nine. Total awards to the United States were four hundred and fifty-seven. The total space occupied by the United States in main building, Machinery Hall, and a special Agricultural Hall, was 2,703 square meters=29,084 square feet.

The price of admission to the Exposition was as follows: Sundays, 50 kreutzers=39½ cents; other days, one florin=47 cents. Total admissions, 7,254,687.

The Exposition was so long being arranged that great dissatisfaction was expressed, and it was first considered a failure; but when, toward the close, everything was put in order, it was admitted to be, in a general sense, a fair success. Even the United States managed to gain considerable credit for the practical character of its exhibits. At first the prices of everything rose to an exorbitant rate, but after the first month they were greatly reduced. There was a strike of cabmen and mechanics, which has generally happened at all great Expositions, which caused much inconvenience, but which lasted only a short time. The attendance was large. On June first there were 28,000 visitors, and on the following day 97,108. The average daily attendance for May was 10,200; for June, 40,537. Days open, 186.

Total admissions	7,254,687
Total receipts for admissions	$964,217
Total average daily admissions	39,003
Largest daily admissions	139,000

California was represented by Guido Kustel, a noted local metallurgist, who did the best in his power to advance the interests of the State. No subscriptions could be collected, and the usual apathy prevailed. Booth & Co. intended to send a ten-stamp quartz mill, but the idea was abandoned.

The following names of California exhibitors appear in the United States catalogue:

Buena Vista Vinicultural Society, of San Francisco, California wines. Nonpareil wine and Buena Vista wines, first and third quality, and Pearl of California. This company received a medal.

Eberhardt & Lachman, San Francisco, California wines. Medal awarded.

Houseworth, Thomas, photographs of California scenery, also received a medal.

Harris, Michael, San Francisco, California marble.

Kimball Carriage Company, San Francisco, light road wagon. Gold medal.

Kustel, Guido, San Francisco, minerals from Utah and California. Medal. Fruit with galvanized metallic coating. Honorable mention.

Muybridge, E. J., San Francisco, photographs and landscapes. Medal awarded.

Neumann, J., San Francisco, raw and spun silk. Medal awarded. This exhibit was placed in the Alabama department, and credited to that State until discovered and restored by Mr. Kustel.

Watkins, C. E., San Francisco, landscape photographs of California scenery. Awarded a medal.

Rather an insignificant showing for the great State of California, but remarkable for the number of awards. It will be seen that there were but nine exhibitors and nine awards. Michael Harris failed, but Mr. Kustel received two.

CHILIAN EXPOSITION, SANTIAGO—1875.

This Exposition was created by a decree of the Chilian Government and was under its protection. The site selected was the Quinita Normal (model farm). The building was architectural, rectangular, two stories high. At each corner were square tower-like buildings with pediment, and at each of the four central entrances arches surmounted by statues. The Exposition was inaugurated September 16, 1875, with imposing ceremonies. Italy, England, and the United States were of all foreign countries the best represented. California was well represented, especially by machinery. An engraving representing the exhibition buildings may be found in the *Mining and Scientific Press*, vol. 29, October 24, 1874, folio 265. The California Commissioner was William C. Quimby, of San Francisco.

UNITED STATES INTERNATIONAL EXPOSITION, PHILADELPHIA—1876; GENERALLY KNOWN AS THE "CENTENNIAL."

This was *par excellence the* great American International Exposition. Whatever may be done in the future, it will be difficult to excel this grand national exhibition, which was admitted by foreigners to be in many respects superior to any before held.

History.

On March 3, 1871, the Congress of the United States appointed the United States Centennial Commission, and June 1, 1872, the Commission was instructed "*to conduct an international exposition of arts and manufactures and products of soil and mine, in the year 1876, in commemoration of the anniversary of American Independence.*" The committee was to consist of one representative of each State and Territory in the Union. The State of California was represented by J. Dunbar Creigh, of San Francisco.

The United States made no appropriation and advanced no funds beyond what was required to engrave certificates of stock and to strike the medals awarded to exhibitors; but the Forty-fourth Congress appropriated $1,500,000 for the use of the Exposition as a loan, which sum was afterwards fully repaid. This was after an unsuccessful attempt had been made to raise funds by subscription. Congress also appropriated $649,250 to make a display of the executive departments of the Government. The Exposition was open for six months, from May 10, 1876, to November 10, 1876.

The opening ceremonies were conducted by Rutherford B. Hayes, President of the United States, in person. After a brief but appropriate speech,

he said: "I declare the international exhibition now open," upon which the great American flag was unfurled, followed by the hoisting of the flags of other nations, ringing of chimes, singing of the hallelujah chorus with organ and orchestral accompaniment, and the firing of one hundred guns. The President of the United States, conducted by the Director-General, then made a tour of the main building. As the procession passed the Foreign Commissioners at their respective departments, they were presented to the President and joined in the procession. In the machinery hall the President and the Emperor of Brazil, assisted by George H. Corliss, started the great engine and set the machinery in motion.

Buildings.

There were two hundred and forty-nine buildings, as follows:

Official Exposition buildings	45	Area, 57.531 acres.
Concessions	41	Area, 4.624 acres.
United States Government	7	Area, 2.634 acres.
Foreign Governments	15	Area, 0.855 acres.
Private exhibits	56	Area, 2.765 acres.
Private exhibits (outside)	41	Area, 0.977 acres.
State buildings	24	Area, 1.991 acres.
Public comfort	20	Area, 0.089 acres.
Totals	249	Area, 71.466 acres.

Total cost of buildings	$5,242,295 83
Which sold for	294,245 75
Loss	$4,948,050 08

Main Building.

This building was 1,880 feet long by 464 wide. It was built of wrought iron, brick, and glass. The roof was of boards covered with tin. It was painted inside and out at a cost of $60,483. The area covered by the building was 20.2 acres.

Total cost	$1,763,600 00
Sold for	250,000 00
Loss	$1,513,600 00

Machinery Hall

Covered 14 acres. It was built at the expense of the City of Philadelphia. It was 1,402 feet long by 360 feet wide. The foundation, five feet high, was of brown stone on a base of granite. The superstructure was of wood. Cost, $634,863 48.

Agricultural Hall

Covered 8.72 acres. Dimensions, 820x540 feet. It was principally wood. 1,111,560 feet of lumber, 211,300 pounds of iron, 243,100 square feet of tin roofing, and 410,000 square feet of felt roofing, and 113,500 square feet of glass were used in the construction.

Total cost	$299,426 62
Sold for	13,100 00
Loss	$286,326 62

Mineral Annex.

This building covered 2.71 acres. It cost $22,007 83, and sold for $1,000.

United States Government Building.

Built principally of wood in the form of a Greek cross. Central nave and aisles, 480x100 feet; cross transept, 340x100; area, 2.33 acres; total floor area, 102,840 square feet. At crossing of nave and transept there was an octagonal dome, above which a large American flag floated. The interior was rough, but was decorated with flags and signals. It was lighted by gas. $578,500 were appropriated for the construction of this building.

Carriage Annex.

Area, 1.95 acres; cost, $60,171 08, and sold for $4,100.

Memorial Hall.

This fine building was 365 feet long by 210 feet wide, and 59 feet high. But little wood was used in its construction. The principal materials used were granite, iron, and glass. It covered an area of 1.5 acres, and cost $1,564,398 56. The art annex covered 1.4 acres, dimensions 395x222 feet; cost $109,045 67, and sold for $3,050.

Horticultural Hall

Was built by the City of Philadelphia, at a cost of $367,073 47. It was 235x80 feet superficial area, and 55 feet high. The materials used in its construction were principally iron and glass.

Grounds.

The total area of the grounds, which were highly ornamental and well kept, was 284.48 acres.

The Exposition was open one hundred and fifty-nine days.

Total admissions	9,910,966
Average daily attendance	62,333
Largest number in one day	274,919
Smallest	12,720

The idea of appointing a special day for each State—known as State days—during which it was expected that citizens should do their best to bring their State into prominence, and to advocate the advantages possessed by it, originated at this Exposition. The same was observed by the representatives of many States at the New Orleans Exposition, and greatly to their credit. At Philadelphia there were ten State days, and twenty-seven addresses were delivered by representatives of other States, but there was no California day nor was there any official address.

Another peculiarity of this Exposition was the institution of a woman's department, which I believe was the first introduction of that feature at any Exposition.

This was in every sense an international Exposition. Twenty-seven foreign countries and seventeen British Colonies were represented.

It will be impossible here to give an elaborate description of this, perhaps the greatest and most successful of all international Expositions, and I regret to say that California did not take sufficient advantage of that golden opportunity, but disappointed her citizens and the world at large.

In the report of the Mineral Annex, the name of California does not appear. The State erected a building jointly with Nevada, and there were a few creditable exhibits, but insignificant when compared with what our State could and should have made. The Commissioners for California were J. Dunbar Creigh and John Middleton, both of San Francisco. The following report on the collective exhibit of California appears in the official reports of the Exposition:

State of California, United States, Collective Exhibit Report.

Commended for a spacious State building containing specimens of the woods of the State, also a very fine exhibit of the natural resources of the State, animal, vegetable, and mineral, made for the citizens of California by the Land Department of the Central Pacific Railroad Company; including a very beautiful shield of the State, about three feet in diameter, carved entirely of the native woods of California; also an exceedingly valuable collection of marine shells of the Pacific Coast, and many interesting specimens of petrifaction.

Cost of the Exposition.

Total expenses		$10,997,980 59
Total income, not including stock account or assets:		
Income account	$4,821,325 78	
Appropriation State of Pennsylvania	1,000,000 00	
Appropriation City of Philadelphia	1,500,000 00	
		$7,321,325 78

PARIS EXPOSITION—1878.

The Paris Exposition—"*Exposition Universelle de 1878*"—was created by decree of the President of the French Republic, which is sufficiently explained by the following extracts from an official letter from M. Bartholdi to Hamilton Fish, Secretary of State of the United States:

Legation of France in the United States,
Washington, May 20, 1876.

Mr. Secretary of State: By two decrees dated respectively the fourth and thirteenth of April last, the President of the Republic decided that a universal exhibition of productions of agriculture, industry, and the fine arts, should be opened at Paris on the first day of May, 1878, and close on the thirty-first of October of the same year. * * * As soon as the regulations and the programme, which the Commission is now preparing, shall have been issued, I shall transmit copies thereof to your Excellency; but I hereby notify your Excellency, by order of my Government, of the opening of this new international exhibition, and through your mediation officially invite the Government of the United States to be pleased to lend its valuable coöperation.

My Government feels confident that the appeal which it addresses to all Governments will be heard; it is convinced that all will respond with sympathy, realizing as they do the advantages of these great enterprises through which nations form new bonds and learn mutually useful lessons, thus insuring the development of their prosperity by labor and peace.

President Hayes, in his message, October 16, 1877, recommended the cordial participation of the American nation in the proposed Exposition.

The Committee on Foreign Affairs reported in favor of an appropriation. Congress, by joint resolution, approved December 15, 1877, accepted the invitation of the French Government to be represented at the Exposition, and authorizing the President to appoint a Commission, to report to the United States under the general direction of the Secretary of State, and appropriating $150,000 to defray expenses. A minority report of Committee on Foreign Affairs reported adversely as to the appropriation. By a subsequent Act of Congress $40,000 more was appropriated.

By the resolution Hon. R. C. McCormick was appointed Commissioner-General by the President and confirmed by the Senate. It was also provided that the Governors of the several States might nominate and the

President appoint two honorary Commissioners. All the States and Territories of the Union accepted this permission. The Governor of California proposed the names of William C. Quimby and Henry G. Hanks, both of whom were commissioned by the President. Mr. Quimby did not go to Paris, and California was wholly represented by Mr. Hanks, who was also appointed Superintendent of the mineral section of the United States, placed on the staff of the Commissioner-General, and made a report on the mineral exhibit of the United States, which was published in Volume I of Reports of the United States Commissioners.

The Exposition was held in the center of the City of Paris; mainly in the *Champ de Mars*, the locality of the Exposition of 1867, and an additional space lying between the river and "*Place du Trocadero.*" The principal buildings of the exposition were the "*Palais du Trocadero*" and the "*Palais du Champ de Mars,*" erected on opposite sides of the River Seine, but connected by a magnificent bridge of stone—"*Pont d'Jéna.*" The Trocadero was crescent-shaped, with a central building containing a grand hall, capable of seating five thousand persons. This grand and beautiful building was constructed in the most substantial manner, and has become one of the national monuments of the City of Paris.

The cost of the Trocadero greatly exceeded the original estimates—5,200,000 francs. It was originally intended to be of perishable material, like the building on the *Champ de Mars*, and to be removed at the termination of the Exposition, but it was considered afterwards that it would be better to construct it of durable materials, and in a style elegant enough to place it in a suitable rank with the monuments of the capital, consequently iron and stone were substituted throughout for wood and plaster. The foundations had to be dug very deep, at a heavy cost; and the quarry work required very considerable labor. To sum up all, the Trocadero palace cost 10,000,000 of francs. The superficial area covered was 16,000 square meters. With its additions it amounted to 620 francs per superficial meter, very much more than the first estimates, but a very moderate cost, when the nature and importance of the construction is taken into account, as well as the rapidity of the execution.

This palace, under decision dated May 1, 1879, became public property; and since then has been assigned to the Minister of Public Instruction. In the agreement with the City of Paris, dated May 14, 1877, the Trocadero (without the grounds) was valued at 3,000,000 francs. The cession made to the Minister includes the palace and 22,000 square meters of land.

The Palace of the Champ de Mars, or, as it was frequently called, the Industrial Palace, was more temporary in its character, and has since been wholly removed, leaving the grounds to their former use: a parade ground for troops in front of the military school "*Ecole Militaire.*" The building was 706 meters (2,316 feet) long by 350 meters (1,148 feet) wide. In the center of this mammoth edifice was the municipal exhibition of the City of Paris. This central building was about 500 feet by 150 feet. Through the center of the Industrial Palace ran the "*Rue des Nations,*" along which special and characteristic buildings were erected by foreign nations. On the sides of the parade ground and in the gardens, all within the inclosures, were a multitude of annexes, both great and small, some national, some private.

The expenses estimated for the construction of the palace of the *Champ de Mars* were 18,000,000 francs; the actual expenses were 23,000,000 francs in round numbers, say an excess of about 28 per cent.

This result was owing to: First—The construction of a basement of more

than 110,000 square meters, which placed the palace on a general level, and furnished abundant resources for ventilation. Second—By making a change in the machinery galleries, which originally projected upon the Polonceau system, they were constructed in a form entirely new, and made much more elegant. Third—The requirements for decoration (awnings, painting, hangings, sculpture, etc.), which are always difficult to estimate in advance. Fourth—In the establishment of the palace entrance on the Seine. Fifth—In projecting the industrial museum which occasioned an additional expense of more than 460,000 francs in the purchase of materials for its location. Finally, the surface covered was about 226,602 square meters. Its cost for construction and maintenance amounts to about 102 francs per square meter.

From the facade of the industrial palace to the Trocadero, a space of about 2,300x1,500 feet through which the river ran, was laid out in most beautiful ornamental grounds and gardens, superior to any I have ever seen elsewhere in the world. The cost of the gardens of the Champ de Mars was estimated at 1,000,000 francs; the expenses amounted to 1,900,000 francs in round numbers. This increase was owing: First—To the work neglected to be done by the foreign exhibitors upon which the management had counted, and which they were obliged to execute instead. Second—To the rainy weather which made the care of the alleys and gardens very expensive. The space maintained for the garden was about 16 hectares. The cost for both was about 12 francs 60 centimes per meter.

In front of the Trocadero a large body of water fell first in a miniature cataract, then in a succession of lesser cascades into a basin. The width of the stream was about 80 feet, and the length, including the basin, about 400 feet. There were four large gilded statues or figures of animals representing the continents. The cost of the gardens of the Trocadero was estimated at 2,260,000 francs—the actual cost was 2,800,000 francs. The excess was explained by the importance given to the central cascade, and the central fountain, and the increase of the aquarium, which cost nearly 360,000 francs.

The French people are proverbially noted for their taste and love of the beautiful, and no stronger proof could be given of this natural trait than the buildings and grounds of the Exposition of 1878. The French exhibits were profuse in works of art, such as statuary, paintings, architectural designs, carvings, modeling, tapestries, laces, terra cottas, mosaics, and a multitude of minor forms of art and design. Besides the exhibits in the Exposition buildings, visitors had access to the grand museums and art galleries of the City of Paris, and at Versailles. No other country can, in my opinion, for many years to come, hope to vie with France in this particular.

The Exposition was formally opened May 1, 1878, at the Trocadero, by the President of the Republic, Marshal MacMahon, Duc de Magenta, who declared the opening in the following words: "In the name of the Republic, I declare the Universal Exposition of 1878 to be opened," after which, in company with the Prince of Wales, the Crown Prince of Denmark, and other distinguished individuals, he made a tour of the buildings and grounds. Nearly all night the city streets were thronged with people. All churches, public buildings, and monuments were festooned with colored lights and Chinese lanterns.

The Exposition was extended from the first to the tenth of November. There were no official closing ceremonies. The steam engines of the United States section were stopped on Saturday night, the ninth, instead

of Sunday the tenth, the official day, after loud and continued blasts by the steam whistles. The closing of the valves which shut off the steam for the last time was performed by M. Birgen, Director of the foreign sections, who, as he slowly turned the throttle, aptly said: "Although France now cuts off the steam by which the United States has proved the greatness of her inventions, I trust nothing will ever sever the friendship between the two countries."

The Exposition was open one hundred and ninety-four days. The total admissions were 16,156,626; daily average, 83,281. The expenses of the Exposition were vastly greater than the estimates. The total expenses of the Exposition actually paid were 55,271,650 francs, equal to $11,054,330, counting the franc at twenty cents, which is a little over the actual value in American money. Besides this, there were large expenses unpaid, which were afterwards specially provided for by the Government.

The following extract from the official reports shows that the excess in expenses did not cause any regret on the part of the French people:

The essential cause of this enlargement of expenses is, as has been seen, the very success of the exhibition. If the original plan had been maintained, many of the expenses would have been avoided; but would it have been truly wise to diminish the success by exercising economy? Such a course was never thought of.

The receipts also fell below the estimates:

Total sale of tickets	$12,283,888 69
Season tickets	115,400 00
Entrances, June 3	29,479 70
National lottery, allowed	950,870 00
	$13,379,638 39
Anticipated returns by estimate, $14,000,000; deficit	620,361 61
	$14,000,000 00

The following, from the official reports, explains the cause of this deficiency:

The principal causes of this deficiency appear to be: first, the donation made to the representatives and agents of exhibitors, to the pupils of the primary schools, etc.; second, the facilities given the foreign Commissioners; third, the persistent rains during the months of June and July, 1878, which detained at home many farmers whose crops were threatened.

In 1867 the total receipts from entrances were 10,765,000 francs.

Resumé of receipts and expenditures as given in official government reports, with concluding remarks:

Deficiency—To resume: The actual expenses were 55,775,000 francs, and the receipts 24,350,000 francs, making a deficit of 31,425,000 francs. The deficiency estimated in 1876 was but ten millions. This deficit is greatly reduced by taking into account the value of the buildings turned over to the various Ministerial Departments, but it is nevertheless important, and surpasses greatly the first estimate.

Managed as a private enterprise, the Exposition would have cost less perhaps, but it would also have brought less honor to our country.

The Government must, on an occasion like this, seek for moral and political results, and these results were obtained beyond measure. Who dares to say they have cost too dear?

Deficiency in American dollars, nearly 6,000,000. The sale of materials amounted to 3,434,226 francs.

France was greatly benefited by the Exposition, and the City of Paris specially so. During the Exposition the five great railroads brought to Paris 12,145,905 passengers, while within the same period in 1877 the number was only 9,552,414. The difference in favor of 1878 was 2,602,491.

On consulting the registers of the Prefecture of the Police, it was found that from the first of May to the thirty-first of October, 571,792 furnished rooms received tenants, of which 353,170 were French, and 218,622 were strangers. In 1877 (ordinary year), during the same period, the number was 263,018, of which only 78,804 were strangers. The receipts at the theaters of Paris in 1878 was (francs) 18,573,009; in 1877, 8,255,931; in favor of 1878, 10,317,078; figures showing that all branches of trade and commerce were benefited, for the patronage of places of amusement is always an index of a condition of prosperity, or otherwise.

CALIFORNIA AT THE EXPOSITION.

In October, 1877, an effort was made to prepare a collection of the products of California, to be sent to the Paris Exposition, held the following year. The Directors and honorary members of the California Immigrant Union named the following gentlemen as a committee to procure and take charge of the California exhibits: R. P. Hammond, J. R. Scupham, W. C. Quimby, J. H. Culver, and Wm. H. Martin; their action being indorsed by the Governor of the State.

At a meeting of this committee, held October 9, 1877, the following gentlemen were named as a special committee on the mineral collection: A. B. Paul, H. G. Hanks, M. Attwood, A. Derre, E. J. Fraser, and J. P. Jackson, of San Francisco; Wm. Watt, of Nevada County; O. C. Hewitt, Amador County; Wm. Fraser, El Dorado County; Wm. Gwinn, Calaveras County; Charles A. Waldeyer, Butte County; John Townsend, Placer County; H. Bellows, Inyo County; E. Burke, Kern County; H. B. Callahan, Lake County; Wm. Streeter, Mariposa County; C. Aaron, Mono County; N. B. Past, Monterey County; J. M. Redway, Los Angeles County; J. B. Randol, Santa Clara County; Charles Nickerman, Santa Cruz County; H. A. More, Siskiyou County; J. Redman, Tuolumne County; C. E. Chubbuck, Colton, California. Nevada—Jas. G. Fair, R. P. Keating, J. W. Grear, H. G. Blaisdell. Arizona—C. C. Bean, A. P. K. Safford, E. P. Voisard, and Jas. Holden.

Several other names were afterwards added to this committee, and a circular was issued by them addressed to the "Miners of the Pacific Coast," soliciting specimens of ores and all useful mineral productions of the coast, and the loan of such as the owners might not wish to part with, and for which the committee agreed to become responsible. Wells, Fargo & Co., and the railroad and steamship companies, generously agreed to transport all contributions free of charge. The Executive Committee, consisting of Messrs. Paul, Attwood, Derre, Jackson, Fraser, and Heydenfeldt, made the following report, which is condensed from the daily papers of the time:

They commenced their labors after being solicited to do so by a general committee, and after assurance of the necessary pecuniary aid to make a display which would do justice to the mineral resources of the Pacific Coast. They worked actively, having faith founded not only on the assurances of those who were the accredited agents of the Commission, but placing further reliance in the men of wealth and position whose names figured so conspicuously in print as promoters of a most commendable undertaking. They incurred obligations amounting to $800, when it became clear that the general committee was without funds. The Legislature was next appealed to, but without avail. A crisis was reached and the effort would have failed, but at this moment Mr. John W. Mackay, of Virginia City, Nevada, touched the wires, notifying the committee of his donation of $5,500 to carry out the work. The public must not forget to award the credit of the Pacific Coast mineral display first to John W. Mackay for his munificent gift, and also to Wells, Fargo & Co., the Central Pacific Railroad Company, Edward Bosqui, and Wm. T. Coleman & Co. To these alone are thanks due, save to the donators of specimens whose names appear on the catalogue, and to your committee whose labors end with this statement of solid facts. Signed by

ALMARIN B. PAUL, Chairman.

This substantial assistance from Mr. J. W. Mackay enabled the committee to forward and exhibit a creditable collection of Pacific Coast minerals in charge of the Commissioner from California.

This exhibition at Paris, which required for the smaller and rarer specimens ten large showcases, besides tables for the larger samples, was a credit to the State, and did a good work in making the riches and extent of California mineral resources known to the world. There were represented 137 gold mines, 92 silver mines, 23 quicksilver, 18 copper, and 287 specimens of various other minerals, shown in groups of 6, 8, 10, and 20 specimens each. The Pacific Coast collection of minerals won a gold medal; attracted much attention, and was visited by scientific men and capitalists from every land.

On the return of the Commissioner to San Francisco, a meeting of the committee on the Pacific Coast mineral exhibit was held to receive his report, after the reading of which the following resolutions were passed:

Resolved, That in view of the great and material benefit which the State of California will derive from the mineral exhibit at the Paris Exposition of 1878, it is the sense of this committee that the State of California is in honor bound to refund to John W. Mackay the sum which he advanced to this committee for the purpose of enabling it to display the minerals of this State.

Resolved, That the thanks of this committee are due to the Commissioner for his able management, and that congratulations be extended to him for his successful carrying out of the aims of the committee.

A joint resolution of the Legislature of California (approved April 7, 1880) acknowledged Mr. Mackay's liberal action in the following terms:

Resolved by the Assembly, the Senate concurring, That the thanks of the people of California are due, and are hereby extended to Mr. John W. Mackay, of Nevada, for the generous and patriotic aid rendered by him to the Commissioners of California appointed by the Governor to represent the State at the Paris Exposition of 1878, by his donation of $5,500 to defray the cost of transmitting a large and valuable collection of specimens from the mineral resources of California to the French capital.

Resolved, That the Governor be requested to forward to Mr. Mackay a certified copy of this resolution, under the seal of the State.

The Commissioner left San Francisco April 21, 1878, and returned October twenty-eighth of the same year.

As there was at that time no State Museum, and as the specimens were specially collected for that Exposition, it was thought best to donate the whole collection to the French Government, which was accordingly done, and the specimens, in which the entire Pacific Coast is represented, are now in the *Ecole des Mines* at Paris. The following letters, relating to the transfer, were sent and received:

EXPOSITION UNIVERSELLE DE PARIS, ETATS-UNIS D' AMERIQUE,
COMMISSARIAT-GENERAL, PARIS, October 2, 1878.

Honorable R. C. McCormick, Commissioner-General:

SIR: I have the honor to transfer to you, on behalf of the State of California, United States of America, duplicate ores, minerals, and type specimens of noted mines of the Pacific Coast; in the name of Mr. John W. Mackay, of Nevada, specimens of rich ores from the silver mines of the Comstock ledge, Nevada, and from Mr. T. Parrott, of California, specimens of cinnabar and sulphur, from the quicksilver mines, known as the "Sulphur Bank," in Lake County, California. These specimens are for the French Government, and were selected and arranged at the request of Senator Krantz, Commissioner-General.

The specimens are all numbered to correspond with the accompanying printed catalogue of the mineral exhibits of the Pacific Coast.

I have the honor to be, very respectfully,

HENRY G. HANKS,
Commissioner for California.

The following letter was received from the Minister of Public Works of France:

[Translation.]

VERSAILLES, February 4, 1879.

Henry G. Hanks, Superintendent of minerals, etc.:

SIR: The Director of the School of Mines has informed me that the State of California has very generously disposed, by gift, in favor of this school, of the very valuable and rare collection of ores, rocks, and minerals, from the Pacific States, which was on exhibition at the Exposition Universelle of 1878.

I desire you, sir, to express my sincere acknowledgment to the government of the State of California for this act of liberality. I also wish at the same time to return you my thanks for the obliging assiduity with which you have represented your Government in this affair.

Receive, sir, the assurance of my highest consideration.

DE FREYCINET.

Aside from the mineral exhibit, California was but poorly represented at the Exposition. The following names only appear on the official catalogues:

Bidwell, John, Chico—Wheat, 63 to 68 pounds per bushel.

Blowers, R. B., Woodland—Raisins.

California—State mineral exhibit.

Cook, Mrs. M. A., San Francisco—Flowers naturally preserved.

Curtis, J. M., San Francisco—Wine heater.

Dietz, Geo. A., Sacramento—Raisins.

Durban, Charles L., Messilla Valley—Raisins.

Hooper, G. F., Sonoma—Native wines.

Muybridge, E. J., San Francisco—Pneumatic clock.

Sutherland, Mrs. M. A., San Francisco, represented by Thomas B. Oakley, Paris—Jewel boxes in California gold and gold quartz.

Tisch, David, Oakland—Pampas grasses.

Weston, U., San Francisco—Photographs.

University of California, Berkeley—College register.

The following prizes were awarded to California exhibitors:

State of California—Pacific Coast mineral exhibit. Gold medal and diploma.

Curtis, J. M., San Francisco—Wine heater. Silver medal.

Hanks, H. G., San Francisco. Silver medal.

Sutherland, Mrs. M. A.—Jewel boxes in California gold and gold quartz. Bronze medal.

INTERNATIONAL EXHIBITION, MELBOURNE, AUSTRALIA—1880.

The locality of this exhibition was so far from Europe and North America that it did not attract the attention it deserved. As far as I can learn, England and the Colonies made the principal exhibits.

Thomas R. Pickering was appointed executive manager on the part of the United States. No State Commissioners were appointed. If California was represented at all, I have no particulars, not having been able to procure any published reports of the Exposition.

DENVER MINERAL EXHIBIT—1882.

This was a somewhat local mineral Exposition, held in Denver, Colorado, in 1882. It was planned to raise the needed funds by the issue of bonds to the amount of $200,000, drawing eight per cent interest. The Exposition was located four miles from the city, to which street cars ran, conveying passengers for ten cents each way. It was early decided that there should be no rewards or premiums. A very stylish architectural building, constructed principally of brick, iron, and glass, was erected, which was ready

to receive exhibits July fifteenth. The building was in the form of a Grecian cross, with towers at the corners, surmounted at the two main entrances by shapely domes. The building was three stories high. The long arm of the cross was 500 feet long, by 120 feet wide. The short arm was 310 feet long, and the same width. The floor space or area, including galleries, contained 120,000 square feet, or less than three acres. An engraving of this building was published in the *Mining and Scientific Press*, vol. 45, folio 129, and the ground plan on folio 185. The Exposition opened August 1, 1882, and closed September thirtieth of the same year.

The duration of the Exposition was sixty-one days. The Legislature of California made no appropriation, and although considerable attention was called to the importance of making a State exhibit by the press of California, no success resulted from the attempts made by private citizens. It was proposed to send the minerals in the State Mining Bureau, but it was found that this could not be done without a special Act of the Legislature. As there was a general opinion expressed that the State Mineralogist could and should take the responsibility, that official addressed a letter to the Attorney-General for information, to which the following reply was received:

Henry G. Hanks, State Mineralogist, San Francisco:

DEAR SIR: After considering the contents of your letter of the third instant, and upon examining the "Act" to provide for the establishment and maintenance of a Mining Bureau, passed April 16, 1880, I am of opinion that the Governor has no control over the specimens and ores in the Mineralogical Bureau, and that, therefore, permission received from him to remove the specimens, for the purpose of placing them on exhibition at the Denver Exposition, would not add anything to the authority of the State Mineralogist.

The geological and mineralogical specimens which have been collected by or under the direction of the State Mineralogist, are in his charge, and if he causes them to be removed from the State, he will be responsible for their safe return.

I regret that I am unable to find any statute authorizing the removal of these specimens. The State Mineralogist, being a statutory officer, has no authority in excess of that conferred upon him by the statute creating the office and prescribing his duties.

The benefits to the State from a proper exhibition of her minerals at the Denver Exposition would be so great that it will be a matter much to be regretted if we are not represented there.

I have the honor to remain, your obedient servant,

A. L. HART, Attorney-General.

SACRAMENTO, California, August 17, 1882.

In his second annual report, 1882, the State Mineralogist alluded to this subject in the following words:

Much was said on the occasion of the recent mineral Exposition at Denver, as to the State being represented. The same controversy will arise from time to time, and it would be well to come to some understanding on this very important subject, and to decide if it is worth while to take advantage of such opportunities, to the credit of the State. If it is proper and politic to do so, some decided action should be taken in time, and appropriations made to carry out that end. This is clearly a matter which interests the whole State, and not only a few extra public-spirited citizens, who are generally called on for funds at the last moment and unfairly criticised if they fail to respond. This is a mild form of blackmail which is not worthy of our citizens. If it is considered proper to have the State represented at future world or domestic Expositions, it is proper for the expense to be borne by the State, which is benefited as a whole. If this matter is considered in time, there would be no difficulty in making a creditable exhibit; but if left until the last moment, collections are made too hastily and sent forward in an unfinished condition. Yet, in the popular enthusiasm it is too often expected that energy will take the place of painstaking detail, which only can effect the purpose.

Mr. Warren B. Ewer, of the *San Francisco Mining and Scientific Press*, was appointed State Commissioner, by which he was invested with the right to represent the State at his own expense, and as no collections had been made of the resources of California, he went to the Exposition empty

handed, to learn that a large space had been reserved for our State in the most conspicuous part of the building.

Mr. Ewer was in Denver at the opening. He sent a series of very valuable and important communications to his paper, and doing the only other thing in his power, made an eloquent address, in which he apologized for the conspicuous absence of a California exhibit, and gave many facts and statistics as to the natural wealth of the State. From his letters we learn the following facts concerning the Exposition:

It was a mistake to place the building so far from the city. The attendance was not so large as was expected. The Exposition, instead of being international or interstate, as was hoped, was local in its character, being the offerings chiefly of the Western States. Colorado made the largest exhibit. The other principal Territories represented were Utah, New Mexico, Arizona, Idaho, Montana, Dakota, and Wyoming. Nevada made a very creditable exhibit. The mineral exhibits were magnificent and imposing; they are described in detail in the Commissioner's letters. An attempt was made to continue the Exposition permanently. The only California exhibitor mentioned was Edward Denniston, of San Francisco, who had silver-plated copper plates for quartz mills, and his stand was made California headquarters. No financial statement of the Exposition was given, although it was regarded as a successful showing of the natural mineral wealth of the great West, which did much to give confidence in the value and permanency of the mines.

NEW ORLEANS WORLD'S INDUSTRIAL AND COTTON CENTENNIAL EXPOSITION—1884-5.

The following general description and history of this Exposition has been taken mainly from the *New Orleans Times-Democrat Almanac for 1885*, and partly from other sources. Much of it is quoted *verbatim*.

HISTORY.

Origin of the Exposition.

The subject of Expositions had been before the people of the South for several years. It was brought notably to the front in a letter of Mr. Edward Atkinson, the well known scientist and expert, which was widely published in August, 1880, and attracted considerable interest. The Expositions of Atlanta and of Louisville were virtually the culminations of this discussion. The idea of making a specialty of a cotton exhibit in an Exposition was suggested by the approach of the centennial of its first export.

The first record of cotton as an industrial product for export from this country is the account of the shipment of six bags (about one bale) from the port of Charleston, South Carolina, in 1784, to England. In one century the export has increased 4,000,000 fold, and the production grown to 7,000,000 bales, and to a value as an export in excess of any known product.

When the scheme was first agitated by the Southern press, it found a host of friends, some of whom allowed their interest to quietly subside before any lasting action was taken.

After a time the design of holding a cotton exhibition simply was abandoned, and the plan enlarged so as to embrace an industrial Exposition of the first order. The highest authority in the land was invoked to give the

proposed Exposition an official existence and recognition among the nations of the earth, and the following Act of Congress was passed:

The Act of Congress.

WHEREAS, it is desirable to encourage the celebration of the one hundredth anniversary of the production, manufacture, and commerce of cotton, by holding, in the year 1884, in some city of the Union, to be selected by the Executive Committee of the National Cotton Planters' Association of America, an institution for the public welfare, incorporated under the laws of Mississippi, a World's Industrial and Cotton Centennial Exposition, to be held under the joint auspices of the United States, the said National Cotton Planters' Association of America, and of the city in which it may be located, and in which cotton, in all its conditions of culture and manufacture, will be the chief exhibit, but which is designed also to include all arts, manufactures, and products of the soil and mine; and whereas, such an exhibition should be national and international in its character, in which the people of this country and other parts of the world who are interested in this subject should participate, it should have the sanction of the Congress of the United States; therefore,

Be it enacted by the Senate and House of Representatives of the United States in Congress assembled, That a World's Industrial and Cotton Centennial Exposition be held in the year 1884, under the joint auspices of the United States Government, the National Cotton Planters' Association of America, and the city where it may be located.

SEC. 2. That the President of the United States may, upon the recommendation of the Executive Committee of the National Cotton Planters' Association of America, appoint six United States Commissioners, and, upon the recommendation of the majority of subscribers to the enterprise in the city where it may be located, appoint seven United States Commissioners, who, together, shall constitute a Board of Management of said World's Industrial and Cotton Centennial Exposition.

SEC. 3. That the President of the United States may, on the recommendation of the Governors of the various States and Territories of the Union, appoint one Commissioner and one Alternate Commissioner for each State and Territory, whose functions shall be defined by the said Board of Management.

* * * * * * * * * * *

SEC. 8. That whenever the President shall be informed by the said Board of Management that provision has been made for suitable buildings, or the erection of the same, for the purpose of said Exposition, the President shall, through the Department of State, make proclamation of the same, setting forth the time at which the exhibition will open, and the place at which it will be held, and such Board of Management shall communicate to the diplomatic representatives of all nations copies of the same, and a copy of this Act, together with such regulations as may be adopted by said Board of Management, for publication in their respective countries.

SEC. 9. That the President be requested to send, in the name of the United States, invitations to the Governments of other nations to be represented and take part in said World's Industrial and Cotton Centennial Exposition, to be held in some city of the United States to be hereafter selected as aforesaid.

SEC. 10. That medals with appropriate devices, emblems, and inscriptions, commemorative of said World's Industrial and Cotton Centennial Exposition, and of the awards to be made to exhibitors thereat, be prepared at some mint of the United States, for the said Board of Management, subject to the provisions of the fifty-second section of the Coinage Act of 1873, upon payment of a sum not less than the cost thereof; and all the provisions, whether penal or otherwise, of said Coinage Act against the counterfeiting or imitating of coin of the United States, shall apply to the medals struck and issued under this Act.

SEC. 11. That all articles which shall be imported for the sole purpose of exhibition at said World's Industrial and Cotton Centennial Exposition, to be held in the year 1884, shall be admitted without payment of duty, or of customs fees or charges, under such regulations as the Secretary of the Treasury shall prescribe; *provided*, that all such articles as shall be sold in the United States or shall be withdrawn for consumption therein at any time after such importations, shall be subject to the duties, if any are imposed on like articles by the revenue laws at the time of importation; *and, provided further*, that in case any articles imported under the provisions of this Act, shall be withdrawn for consumption or shall be sold, without payment of duty as required by law, all penalties prescribed by the revenue laws shall be applied and enforced against such articles and against the persons who may be guilty of such withdrawal or sale.

Location.

The Exposition thus organized, the next thing was the selection of the proper spot for it. This matter was discussed for some time by the Cotton Planters' Association. It was at first proposed to leave it open to bids, the city making the highest bid to have the Exposition. This project, however, did not promise well, and public opinion generally settled down on New

Orleans as the proper location, it being the largest city in the South, centrally located, and the greatest cotton port in the world. It was accordingly proposed that, if New Orleans would guarantee the amount necessary to assure the success of the Exposition, it would be fixed there. This being done, New Orleans was officially chosen as the seat for the World's Industrial and Cotton Centennial Exposition.

ORGANIZATION.

The organization provided for under the Act of Congress, incorporating the Exposition, was finally completed, with the following officers:

Edmund Richardson, President; Albert Baldwin. First Vice-President; William B. Schmidt, Second Vice-President; Samuel Mullen, *Secretary; Thomas H. Hunt, †Treasurer; E. A. Burke, Director-General; F. C. Morehead, Commissioner-General.

Board of Management—Edmund Richardson, Albert Baldwin, William B. Schmidt, F. C. Morehead, Governor R. M. Patton, Thomas Hardeman, Jr., Duncan F. Kenner, E. M. Hudson, Jules C. Denis, Simon Hernsheim, Samuel H. Buck, John V. Moore, G. A. Breaux.

Advisory Finance Committee—Hon. W. J. Behan, Chairman; Robert S. Howard, Jos. H. Oglesby, A. J. Gomila, C. M. Soria.

General Finance Committee—Hon. W. J. Behan, Chairman; Clement L. Walker, Secretary; Jules Aldigé, Bertrand Beer, A. S. Badger, A. Brittin, Jesse K. Bell, Charles A. Butler, E. L. Carriere, John Chaffe, H. Dudley Coleman, E. P. Cottraux, E. F. Del Bondio, James D. Edwards, B. F. Eshelman, John W. Fairfax, R. F. Gray, A. J. Gomila, Robert S. Howard, Andrew Hero, Jr., Frank T. Howard, Sigmund Katz, Carl Kohn, Victor Latour, E. T. Manning, A. A. Maginnis, P. R. Middlemiss, Adolphe Meyer, B. J. Montgomery, A. J. Michaelis, E. Miltenberger, Joseph H. Oglesby, J. G. Schriever, C. M. Soria, Adam Thomson, E. A. Weeks, Joseph A. Walker, E. B. Wheelock, E. D. Willett, B. D. Wood.

*Samuel Mullen resigned his office July twenty-second, and Richard Nixon was elected Secretary.
† Thomas H. Hunt died May 7, 1884, and John B. Lafitte was elected Treasurer May twenty-seventh.

Subscriptions.

This was the preliminary organization of the Exposition, the foundation from which it afterwards arose. It gave it, however, only an organization, nothing more, and the Board of Management began at once active operations to secure popular subscriptions. Appeals were made to the citizens of New Orleans to subscribe to the Exposition stock and a thorough canvass of the city begun for this purpose. These efforts were crowned with success. The citizens, corporations, street and trunk railroad companies, subscribed liberally, raising the needed $500,000. An appeal made to the City of New Orleans brought a donation of $100,000, to be devoted specially to the erection of a horticultural building, that should remain after the Exposition was over and become the property of the city. The State of Louisiana contributed $100,000, and various other States from $5,000 to $30,000 each. When a sufficient amount had thus been realized to assure the success of the Exposition, an appeal was made to the Federal Government to grant similar aid to that given the Philadelphia Centennial in the form of a loan, the Government to advance $1,000,000 to the Exposition, to be paid back out of the first earnings. Such a loan was warmly recommended by President Arthur, and when the bill making it came before Congress, it was adopted with wonderful unanimity. This made the total direct subscription to the Exposition $1,608,000.

Thus recognized by the Federal Government, the Exposition suddenly acquired new force and promise, and its aims and designs were greatly enlarged. In the meanwhile, our Ministers and Consuls abroad had notified foreign Governments that a grand international exhibition was going to be held here, and these foreign Powers were invited to send their representatives and exhibits.

This invitation was accepted by nearly all the invited Powers, and a majority of these countries began at once to make preparations for their displays, making appropriations to this end. Of these the most generous was Mexico, which, through the Federal Government of that republic and the several individual Mexican States, appropriated nearly $250,000 for a complete and thorough Mexican exhibit, including the erection of two handsome buildings for headquarters and for exhibits on the grounds, and the sending of two regiments of Mexican troops, one cavalry, the other infantry, to remain in New Orleans during the Exposition. The various Central American republics made similar handsome appropriations. Throughout the world the same interest was shown in the Exposition, and such far distant countries as Siam and Liberia set aside considerable sums for national displays. The cities followed the examples of the States, nearly all the leading towns having raised funds for the purpose of securing exhibits of their manufactures, industries, etc.

Thus provided with ample funds, the managers set about the task of erecting the necessary buildings, making the scope and general characteristics of the Exposition better known, and issuing invitations to possible exhibitors, so as to secure a full display.

Work in all these branches was continued simultaneously. The Commissioner-General, as well as the European and other Commissioners, traveled from point to point, arousing popular interest in the Exposition, and securing appropriations for it. The supervising architect, with a large force of men, continued the work of erecting the necessary buildings, while from the central office, documents and papers were sent over the world to make known the aims and purposes of the Exposition.

Officers.

The following officers were appointed to carry out this work of erecting the buildings, attending to and adorning the ground, collecting exhibits, etc.:

E. A. Burke, Director-General and Chief Executive Officer.
F. C. Morehead, Commissioner-General.
G. M. Torgerson, Supervising Architect.
F. N. Ogden, Chief Superintendent.
S. H. Gilman, Consulting Engineer.
Parke Earle, Chief of Department of Horticulture.
George B. Loring, Chief of Department of Agriculture.
B. K. Bruce, Chief of Department of Colored Exhibits.
Samuel Mullen, Chief of Department of Installation.
Charles L. Fitch, Chief of Department of Transportation.
B. T. Walshe, Chief of Department of Information and Accommodation.
Thomas Donaldson, Chief of Department of Ores, Minerals, and Woods.
John Eaton, Chief of Department of Education.
Wm. H. H. Judson, Chief of Department of Printing and Publishing.
Charles W. Dabney, Jr., Chief of Department of Government and State Exhibits.
Mrs. Julia Ward Howe, Chief of Department of Women's Work.

Exposition Park.

While these various officers were being chosen, the Board of Management had finally selected suitable grounds for the Exposition in the Upper City Park, belonging to the City of New Orleans. The park boasts of many advantages. It is a level tract of land, containing two hundred and forty-nine acres, naturally adorned with groves of live oak, with a splendid view of the river, and within easy reach of New Orleans, either by a number of horse car lines or by way of the river, as it faces directly on the Mississippi. The use of this ground was given the Exposition by the city, and work was begun at once on the buildings to be erected there.

Commissioners.

Under the Act creating the Exposition it was provided that the President should, upon the recommendation of the Governors of the several States and Territories, appoint one Commissioner and one alternate for each of them. These appointments were accordingly made by him as follows:

Alabama—E. S. Pratt, Commissioner, Mobile; H. L. Stoutz, alternate, Selma.

Arkansas—C. M. Taylor, Commissioner, South Bend; Sterling R. Cockrill, alternate.

California—Col. A. Andrews, Commissioner, San Francisco; John H. Carroll, alternate, Sacramento.

Colorado—H. T. Sickles, Commissioner, Alamosa; Noel May, alternate, Denver.

Connecticut—Thomas F. Plunkett, Commissioner, Hartford; Benjamin E. Mallory, alternate, Mystic Bridge.

Delaware—William Dean, Commissioner, Newark; Chas. H. Preat, alternate, Georgetown.

Florida—W. H. Sebring, Commissioner, Bronson; W. D. Chipley, alternate, Pensacola.

Georgia—Dewitt C. Bacon, Commissioner, Savannah; Chas. N. Smith, alternate, Castroville.

Illinois—Hon. Frank J. Gilbert, Commissioner, 85 Madison Street, Chicago; Lewis B. Hibbard, alternate.

Indiana—J. R. Carnahan, Commissioner, Indianapolis; W. F. Nisbet, alternate, Evansville.

Iowa—H. S. Fairall, Commissioner, Iowa City; John S. Ely, alternate, Cedar Rapids.

Kansas—Hon. Frank Bacon, Commissioner, Chanute; Hon. G. Y. Johnson, alternate, Topeka.

Kentucky—Judge G. T. Perkins, Commissioner, Covington; E. Polk Johnson, alternate, Louisville.

Louisiana—C. J. Barrow, Commissioner, Port Allen; W. I. Hodgson, alternate, New Orleans.

Maine—J. D. Ham, Commissioner, Lewiston; M. S. Howe, alternate, Biddeford.

Maryland—George W. Bishop, Commissioner, Barnum's, Baltimore; J. Thomas Sharf, alternate, Baltimore.

Massachusetts—J. Howard Nichols, Commissioner, Boston; Edward S. Bradford, alternate, Springfield.

Michigan—A. P. Swineford, Commissioner, Marquette; F. M. Carroll, alternate, Grand Rapids.

Minnesota—Oliver Gibbs, Jr., Commissioner, Lake City; Samuel E. Adams, alternate, Monticello.

Mississippi—S. A. Jonas, Commissioner, Aberdeen; A. B. Hurt, alternate, Winona.

Missouri—F. F. Hilder, Commissioner, 620 Chestnut Street, St. Louis.

Nebraska—Ex-Governor R. W. Furnas, Commissioner, Brownsville; A. Vance, alternate, Osceola.

Nevada—Col. C. C. Thomas, Commissioner, Sutro; George Russell, alternate, Elko.

New Hampshire—George W. Riddle, Commissioner, Manchester; D. W. Johnson, alternate, Claremont.

New York—D. J. Johnson, Commissioner, Cohoes; Eph. Chamberlain, alternate, Utica.

North Carolina—Hon. George Howard, Commissioner, Tarboro; J. Turner Morehead, alternate, Leaksville.

New Jersey—Hon. C. H. Barney, Commissioner, 259 Washington Street, Jersey City; Joseph H. Reynolds, alternate, Camden.

Ohio—Homer Hamilton, Commissioner, Cleveland; J. W. McDymonds, alternate, Massillon.

Oregon—J. Mayer, Commissioner, Portland; T. B. White, alternate, Albany.

Pennsylvania—A. E. Lewis, Commissioner, Milford; R. H. Thomas, alternate, Mechanicsburg.

Rhode Island—Arnold B. Chace, Commissioner, Valley Falls; Hezekiah Conant, alternate, Pawtucket.

South Carolina—A. P. Butler, Commissioner, Columbia; W. S. Mauldin, alternate, Greenville.

Tennessee—A. J. McWhirter, Commissioner, Nashville; John Stack, alternate, Bristol.

Texas—T. T. Gammage, Commissioner, Palestine; H. C. Cook, alternate, Meridian.

Vermont—I. P. Mead, Commissioner, Montpelier; Henry G. Root, alternate, Bennington.

Virginia—Dr. J. M. Blanton, Commissioner, Richmond; James B. Pace, alternate, Richmond.

West Virginia—Philip Pendleton, Commissioner, Berkeley Springs; Alexander Campbell, alternate, Bethany.

Wisconsin—Hon. E. D. Holton, Commissioner, 613 Grand Avenue, Milwaukee; J. M. Smith, alternate, Green Bay.

Territories.

Arizona—Frank M. Murphy, Commissioner, Prescott; Douglas Gray, alternate, Prescott.
Dakota—Alex. McKenzie, Commissioner, Bismarck; John A. Gaston, alternate, Deadwood.
Idaho—George L. Sharpe, Commissioner, Salmon City.
Montana—John S. Harris, Commissioner, Helena; Hon. W. A. Clark, alternate, Butte.
New Mexico—Prof. P. Langhammer, Commissioner, Cerillos; Col. F. A. Blake, alternate, Socorro.
Utah—Jacob Laurence, Commissioner, Salt Lake City; Wm. G. Galligher, alternate, Salt Lake City.
Washington—A. P. Sharpstein, Commissioner, Walla Walla; Hon. C. E. Ferguson, alternate, Walla Walla.
Wyoming—Hon. Homer Morrell, Commissioner, Rawlins; Rev. Geo. C. Rafter, alternate, Cheyenne.

Department of Agriculture.

The Chief of the Agricultural Department was the Hon. George B. Loring, of Massachusetts, United States Commissioner of Agriculture. The executive management was under the superintendence of the Hon. George Y. Johnson, Secretary of the Kansas State Fair, Topeka, who divided the department into the following parts, and assigned them dates and premiums as here given:

Division A—Fat stock, December to January, Edward Hannon, Kansas City, Missouri, Superintendent.
Division B—Horses, mules, and donkeys. Commenced to receive stock December 20; opened formally December 25; closed January 25. Dexter Curtis, Madison, Wisconsin, Superintendent.
Division C—Dogs. January 10 to January 20. Charles Lincoln, Detroit, Michigan, Superintendent.
Division D—Poultry and pet stock. January 15 to February 15. B. N. Pierce, Indianapolis, Indiana, Superintendent.
Division E—Cattle. January 25 to March 1. Samuel Dysart, Franklin Grove, Illinois, Superintendent.
Division F—Dairy products. December 10 to May 31. Dairy tests from February 10 to February 20. Charles E. Marvin, Rochester, Minnesota, Superintendent.
Division G—Sheep and goats. January 25 to March 1. John A. Cross, Cleveland, Ohio, Superintendent.
Division H—Swine. January 25 to March 1. W. Scott Baker, Franklinville, New York, Superintendent.
Division I—Farm and garden products. December 10 to May 31. George C. Brackett, Lawrence, Kansas, Superintendent.
Division J—Farm machinery and utensils. December 10 to May 31. Thomas H. Glenn, Chicago, Illinois, Superintendent.
Division K—Machinery for production of agricultural products. December 10 to May 31. Sylvanus Burtis, Superintendent.
Division L—Humane inventions. George T. Angell, Boston, Massachusetts, Superintendent.
Division M—Buildings department of agriculture. M. Updike, Superintendent.

Dairy Products.

The following committee constituted the Executive Committee of the Dairy Division:

D. W. Curtis, Fort Atkinson, Wisconsin.
W. D. Hoard, Fort Atkinson, Wisconsin.
Hon. Hiram Smith, Sheboygan Falls, Wisconsin.
Col. R. M. Littler, Secretary Produce Exchange, Chicago, Illinois.
Col. R. P. McGlincy, Secretary Elgin Dairy Board of Trade, Elgin, Illinois.
C. C. Buel, Rock Falls, Illinois.
C. A. Huston, Cedar Rapids, Iowa.
Jos. Sampson, Storm Lake, Iowa.
John Moody, Perry, Iowa.
J. W. Sheppard, St. Louis, Missouri.
C. A. Lawrence, New Orleans, Louisiana.
G. W. Simpson, Boston, Massachusetts.
Joseph Real, New York City.

Department of Colored Exhibits.

Hon. B. K. Bruce, Chief Department Colored Exhibits. The following were the honorary State Commissioners:

Hon. Henry Demas, New Orleans, La.
A. Dejoie, New Orleans, La.
Peter W. Ray, Brooklyn, N. Y.
John S. Leary, Fayetteville, N. C.
Rev. James Poindexter, Columbus, O.
Alexander Ferguson, Portland, Or.
Rev. B .T. Tanner, Philadelphia, Pa.
Rev. M. Van Horn, Newport, R. I.
Hon. J. C. Clausen, Charleston, S. C.
Hon. J. C. Napier, Nashville, Tenn.
Joseph Cuney, Galveston, Texas.
Frank Harris, St. Albans, Vt.
Ed. A. Randolph, Richmond, Va.
Chas. Ankrum, Clarkesburg, W. Va.
J. W. Birney, La Crosse, Wis.
J. W. Cromwell, Washington, D. C.
D. P. Hamilton, Wilmington, Del.
Hon. E. C. Smith, Bloomington, Ill.
James T. Bradford, Baltimore, Md.
P. Joseph, Mobile, Ala.
Hon. N. W. Gibbs, Little Rock, Ark.
P. A. Bell, San Francisco, Cal.
Hy. O. Wagoner, Denver, Col
St. John Appo, Hartford, Conn.
Rev. J. E. Lee, Jacksonville, Fla.
Hon. W. A. Pledger, Atlanta, Ga.
W. H. Russell, Indianapolis, Ind.
Alex. Clark, Muscatine, Iowa.
J. L. Waller, Atchison, Kan.
W. J. Simmons, Louisville, Ky.
A. H. Grimke, Boston, Mass.
S. C. Watson, Detroit, Mich.
E. P. Wade, St. Paul, Minn.
M. M. McLeod, Jackson, Miss.
J. J. Bruce, Brunswick, Mo.
E. R. Overall, Omaha, Neb.
John G. Cutler, Hampton, N. H.
R. Henri Herbert, Trenton, N. J.

James Lewis, Esq., Chief of Department of Information and Accommodation (colored), with office at 16 Union Street, New Orleans.

Scope of the Exposition.

The following is an enumeration of the different groupings of exhibits:

1. Agriculture.
2. Horticulture.
3. Pisciculture.
4. Ores and minerals.
5. Raw and manufactured products.
6. Furniture and accessories.
7. Textile fabrics, clothing, and accessories.
8. The industrial arts.
9. Alimentary products.
10. Education and instruction.
11. Works of art.
12. Natural history.

These include everything that can possibly be shown at an Exposition, fair, or other similar display.

GENERAL DESCRIPTION.

The Grounds.

The ornamentation of the grounds was made a matter of special consideration, the general idea being to give effect to the tropical and semi-tropical plants flourishing in Louisiana. For this purpose the general design of ornamentation included Mexican, Central American, Californian, and Floridian gardens, showing the flora of those respective countries and States, particularly the evergreens and those plants flourishing and blooming in the Winter. Groves of orange, banana, lemon, mesquite, and maguey were laid out. Through these ran winding paths, while around the grounds were scattered mounds of flowers, under the shady shelter of the grand guardian oaks adorned with long graceful pendants of Spanish gray moss. Fountains and lakes, all things, in fact, that could delight the eye, were provided, presenting a grand view when lit up at night by the electric light. In the center of the grand lake, lying between the main and the United States Government buildings, named Lake Rubio, in honor of the wife of

President Diaz, of Mexico, 100 feet of fountain stand-pipe rose, throwing out three jets at intervals of twenty-five feet.

Electric Lights.

On the top of a spire rising fifteen feet above this column, an electric light of 100,000 candle power threw its radiance over the falling jets of the fountain and across the waters of the lake. In front of the five principal entrances, a 36,000 candle power electric light was placed, and in five different sections of the grounds, towers 125 feet high were lighted by ten standard arc lamps. Fifty additional standard arc lamps were arranged around the grounds and steamboat landing on the river front.

The Art Hall, Music Hall, and the offices of the management, were lighted by 4,800 Edison incandescent lights, the largest incandescent plant in the world, requiring twelve machines and forty miles of wire, enough to completely light a city of 25,000 inhabitants.

The main building was illuminated by the Louisiana Electric Light Company, requiring a plant of 800 arc lights of 2,000 candle power each.

The Government Building was lighted by the Brush electric light, which furnished 300 arc lights for this purpose. It also gave the Exposition the largest single electric light in the world—one of 100,000 candle power.

Chimes.

The chime of fifteen bells was located in the principal tower of the Main Building, and was played regularly daily from 12 to 1, and from 4 to 5 o'clock. Evening concerts were given.

Professor Widdows, of Washington, of Philadelphia Centennial fame, was the performer, and the bells were from the well known foundry of McShane, Baltimore. By a telephonic connection with the organ in Music Hall, the chimes could be played with the organ, and later with the Mexican band. The chimes were accessible to all visitors, and Professor Widdows welcomed all who visited his tower, to which no fee was charged.

Distribution of Exhibits.

On entering the main portals of the Main Building, the first division or section of exhibits, twenty-four feet in width, with an aisle on either side and extending along the whole front and the larger portion of the river side, was devoted to raw and manufactured products, ore, minerals, and woods.

Just inside of this and running parallel with it, was the next division, for textile fabrics, clothing, and accessories. This was forty-eight feet in width and extended along the whole front of the building.

Along the whole front, just inside the above and forty-eight feet in width, was the section devoted to alimentary products. The next section nearest the center, and twenty-four feet in width, was that for educational exhibits. At right angles with this was the spaces for the various nations of the earth. To the right of Music Hall were Russia, Belgium, Germany, Japan, Siam, China, Turkey, and Asia Minor, and beyond these, agricultural implements. To the left were Austria and Hungary, Italy, Portugal, Spain, France, Great Britain, Denmark, Sweden and Norway, South America and Central American countries, and last and nearest the river, the large space for Mexico.

The entire upper side was devoted to machinery and engines. The Director General's office was just left of the main entrance, and the railroad

ticket office just to the right, attached to which were the transportation and telegraph offices.

The United States exhibits and those of the several States were located in the Government Building.

Horticultural exhibits were confined to Horticultural Hall, and similarly, the lumber products were seen in the sawmill building, the cotton machinery in the cotton building, and so on.

The Machinery Department.

The machinery was erected under the direction of Mr. S. H. Gilman, Chief Consulting Engineer. The department possessed a motive power of twenty batteries of steam boilers, aggregating 5,200 horse power. The largest engine was a Corliss of 650 horse power. The work to be done by the twenty-four engines comprised the driving of 11,000 feet of shafting, the furnishing of power to exhibitors, and to the forty or more dynamos of the Edison, Brush, and Louisiana Electric Light Companies. These alone required about 2,000 horse power.

Samuel Smith, Esq., of the firm of Smith, Myers & Scheur, Cincinnati, Ohio, was Superintendent of Machinery Hall, and Samuel Webber, Esq., of New Hampshire, Mechanical Engineer and Aid to the Chief of Installation in locating machinery.

The Water Supply

Consisted of two compounding duplex Worthington pumps, having a capacity of 4,000,000 gallons in twenty-four hours. They were located in a special pumphouse at the southwest corner of the park, next to the river.

This plant distributed the water through upwards of five miles of pipe, and furnished it to every building in the park, besides supplying the numerous fountains on the grounds. The Main Building alone contained over 10,000 feet of water pipe, with fifty-six fire hydrants, so distributed that five streams of water could be turned on to any point at fifteen seconds notice. The Government Building was equally well protected, besides which there were large pumping engines arranged to throw water at call, both on the Exposition buildings and many of those outside the grounds.

This entire water system was under a constant pressure from a standpipe 100 feet high and forty-two inches in diameter, in which the water was kept continuously at a height of ninety-five feet.

Special Features.

The World's Industrial Exposition presented several special and striking features, as compared with all previous ones.

What were termed "Tropical Displays" were peculiar to it, and so extensive as to be almost a leading feature. In fruits, flowers, plants, and forestry, in cultivated products, in export woods, in mineralogical samples, in native manufactured products, in rich archæological stores, the exhibits of Mexico, the countries of Central and South America, and the West Indies, were complete and comprehensive, unitedly composing an extraordinary display. China, Japan, Persia, Siam, and Australia, also contributed largely to the splendor of the occasion. The exhibits from Great Britain, France, Belgium, Russia, Italy, Germany, and other European countries were large and varied.

The exhibits of the General Government, in magnitude and variety, far exceeded any previous display made by it, not excepting even the magnificent display at the Philadelphia Centennial.

The cotton exhibit, showing cotton from the seed to the textile fabric, through the numerous processes it has to pass, was unique, attractive, and interesting.

The sugar and rice exhibits, displaying the processes of cultivating, harvesting, and manufacturing these crops, all practically demonstrated, have never been seen before at any Exposition.

The live stock display was an interesting feature, including not only cattle, horses, mules, sheep, and hogs, but that useful animal, the dog. A very liberal premium list was offered in this department.

The electrical display was complete; the grounds and buildings being illuminated by the different electric light companies of the world, enabling all to compare their advantages.

The machinery exhibit was enormous, including nearly every variety of machinery used, and especially all those of recent invention.

The exposition of woman's work was an important feature, the desire being to show what woman is doing in all branches of taste, skill, and industry. To this department the Board of Management appropriated $50,000 to assist in making their exhibit complete and interesting.

Another special feature was a department devoted especially to an exposition of the work and progress made by the colored race. The Board of Management assigned the sum of $50,000 to this department also, and the entire galleries of the Government Building were given up to it.

Accommodation Bureau.

A special feature of the Exposition, extremely agreeable and advantageous to visitors, was the Department of Accommodation and Information, organized for the purpose of providing for the visitors to the Exposition, and seeing that they were properly housed and cared for. This department made a thorough canvass of New Orleans during the Summer and Fall, and listed and classified accommodations, covering provision for 50,000 persons, the rates of board ranging from $1 to $3 per day. The main office was in direct communication by telephone and messenger service with the different district offices, by which prompt information was at all times available to the visitor.

The Exposition grounds were reached directly by five lines of street cars and two of steam; by the river, water craft of every character could land at the gates.

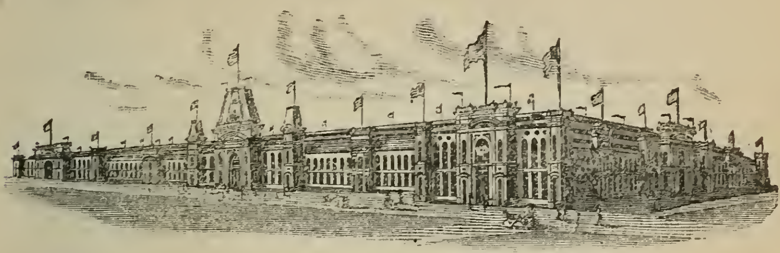
Premiums.

Premiums were provided for the agricultural and stock departments, for the dairy department, and for agricultural and other machinery, a large amount having been set aside by the managers for this purpose. The Exposition itself awarded premiums for oxen, milch cows, horses, mules, sheep, dogs, etc.; for the largest yield of milk, butter, and cheese; for the best displays of certain grain and other agricultural products. The New Orleans Cotton Exchange also offered a handsome list of premiums for cotton exhibits, and other organizations did the same for other articles and displays. In addition to these money premiums, handsome medals were awarded the best exhibits in every department and bureau of the Exposition.

BUILDINGS.

The architect of the Exposition buildings, Mr. G. M. Torgerson, is a Swede, who came to this country in 1867, and settled in the South. His

first success was at Water Valley, Mississippi. When bids were advertised for he sent in plans which were accepted. He has furnished plans required for this report, to be found at the end of this volume, which, I believe, are now for the first time published.



The Main Building.

Plans of this building were open for general competition.

The Main Building was the largest ever erected, and covered thirty-three acres of ground. It was 1,378 feet long by 905 feet wide, without courts, and had a continuous roof composed largely of glass so arranged as to afford an abundance of light without subjecting the interior to the direct rays of the sun. Within, the view was unobstructed. From one side or corner of the building to its opposite, the interior showed all the phases of the exhibit at a glance. There were no partitions, and the lofty pillars, wide apart, supporting the roof structure, presented no impediment to one's vision, but only served to assist the eye in measuring the vast expanse. Wide and spacious galleries, twenty-three feet high, were reached by twenty elevators supplied with the most approved safety appliances, and convenient stairways. The view from them at any and every point was simply superb.

The machinery department occupied a space of 1,378 feet long by 300 feet wide, within the Main Building, and had an iron extension 570 feet long by 120 feet wide, for factories and mills in operation. From the galleries overlooking it, over two miles of shafting could be seen rapidly revolving, driving every known character of machinery.

Music Hall, with a seating capacity, in commodious chairs, for eleven thousand people, a platform capacity for six hundred musicians, and a mammoth organ built to order for the Exposition, occupied the center of the interior.

The Main Building contained the general exhibits, and was situated about in the center of the grounds, a fine view of it being presented from the river, from the city, or from St. Charles Avenue, and showing its resemblance to the palace of the Louvre in Paris.

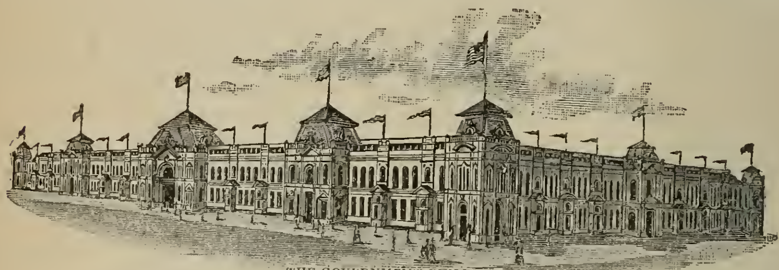
The following figures, showing the total cost of this building, were furnished by Mr. Torgerson:

The net total cost of labor for the construction of the main building amounts to $203,646, representing 94,823 working days, of ten hours. Work was commenced on the main building on the fourteenth day of March, 1884, and it was ready for occupation in time for opening, on the first of December. 9,000,000 feet of lumber were required for the main building. The contract to deliver it in one hundred and five days was awarded to Poitevent & Farre, lumber dealers and producers of New Orleans, who have extensive sawmills at Pearlington, a town on Pearl River, Hancock

County, Mississippi, on the margin of a magnificent growth of timber. The capacity of their mills is 50,000 feet per day. These gentlemen were called on to overcome many difficulties in fulfilling their contract. All the lumber had to be hauled six miles by teams, over muddy roads, during violent rain storms.

The roof of this immense building was so vast that the question of its proper covering was one of cost as well as quality and usefulness. The contract was taken by the Cincinnati Roofing Company, and the materials were shipped from that city all ready to put in place. The material was first covered with asphaltum, and sanded over with some white material to resist the softening effect of the sun's rays. It was claimed that this roof was fireproof, but upon what grounds I did not learn. The area of this roof was about 1,300,000 square feet. Materials used in the construction of the main building:

Timber	9,809,500 feet.
Glass	312,200 square feet.
Nails	301,600 pounds.
Wrought iron	222,356 pounds.
Cast iron	36,920 pounds.



THE GOVERNMENT BUILDING.

United States and State Exhibits, generally known as the Government Building.

The second building in size was that erected for the United States Government and State exhibits. This was 885 feet long by 565 feet wide. At the time of the adoption of the plans it was supposed that the main building, having the largest capacity of any building heretofore erected, in conjunction with the horticultural hall and such minor outside buildings as were necessary, would afford ample space and accommodation for all exhibits; but the interest in the World's Exposition had become so widespread, and the applications and inquiries for space so numerous, that the necessity for additional accommodation became imperative, and the management determined upon the erection of this magnificent structure, especially for the General Government. In addition to the Government exhibits, the collective State exhibits and the general educational display were located there.

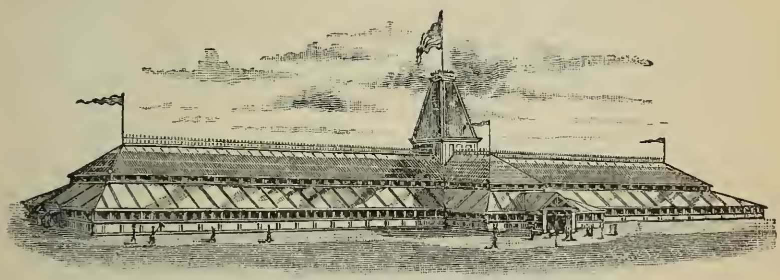
The building was in the renaissance style of architecture. Although it was only forty-three feet high, the altitude was heightened by a series of towers that give to the structure a fine and imposing effect. The roof, or rather series of truss roofs, were managed by the architect in the same ingenious way that was found so effective in the construction of the main building. The interior was a vast open space, being free from partitions or objects calculated to obstruct the general view. The center of the building was devoted to the Government exhibits. The Departments of State, Army, Navy, Post Office, Interior, etc., here found room for the largest and most

complete exhibits that have yet been known. Around these were congregated the exhibits of the several States and of the railroad companies, such as the Union Pacific, Louisville and Nashville, and others. In the galleries were the exhibits of the special department designed to show the industry and progress of the colored race. There were forty pavilions one story high let into the sides of the building, and they served the double purpose of lending architectural adornment and increasing the space allotted to exhibits. The gallery was twenty-one feet from the lower floor and forty feet wide. Numerous skylights and windows served to light the interior.

The most conspicuous and effective structural features were four towers, one in the center of each facade, reaching the height of ninety-six feet. At the base of each was one of the main entrances.

The following cost figures are furnished by the architect: The construction of the Government building, for labor, $108,740, and contains as follows: 5,275,000 feet of lumber, 175,000 square feet of glass, 160,000 pounds nails, 61,722 pounds wrought iron.

On the fifteenth day of August, 1884, the Board of Management gave orders for the construction of the Government Building, and in sixty working days the roof was on. In the beginning of November a Nebraska State official arrived with exhibits and commenced the installation of the same. The other States soon followed suit. At this time the inclemency of the weather commenced to seriously interfere with the progress of the inside finishing of the building, especially in the transportation of materials. The rain made the roads impassable, hence the decision of the management to postpone the opening until the sixteenth of December.



The Horticultural Hall.

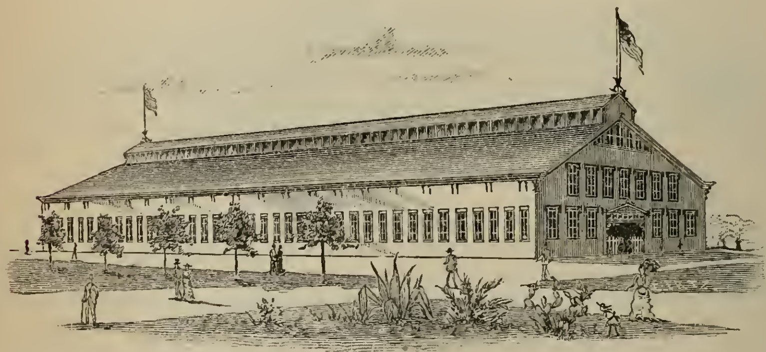
The third building in size, and a conspicuous feature of the group, was the Horticultural Hall, which was 600 feet in length and 194 feet wide through the center. It was the largest conservatory in the world. It was substantially built as a durable structure, becoming, by arrangement with the city, a permanent feature of the Park. It was located on high ground in the midst of magnificent live oak groves. Surmounting the center was a tower 90 feet high, roofed with glass. Beneath this tower, in constant play, was a grand fountain. Extending through the center of the hall 25,000 plates of fruit, double the amount ever before displayed at any Exposition, were exhibited. Around the hall were arranged an infinite variety of rare tropical and semi-tropical plants, flowers, and shrubbery, gathered from every available source. Above this display, on a fair decline, the roof appeared almost like a solid plate of glass. In the central

hall, with a much higher roof, only partially of glass, was located a tropical hothouse, 250 feet long by 25 feet wide, in which the most delicate flowers from the far south were nurtured and made to bloom in their most brilliant perfection. Tropical fruits in the various stages of growth were also exhibited. By arrangements for stated supplies and through processes of preservation and cold storage, fruits of every section and the production of all seasons were available for exhibit.

The most eminent horticulturists of the United States arranged and perfected the display. Cash premiums to the amount of $32,000 were offered in this department, and contributions to its exhibits from Mexico, Central America, the West Indies, and the different States of the Union, were unprecedently large and varied.

The Art Gallery.

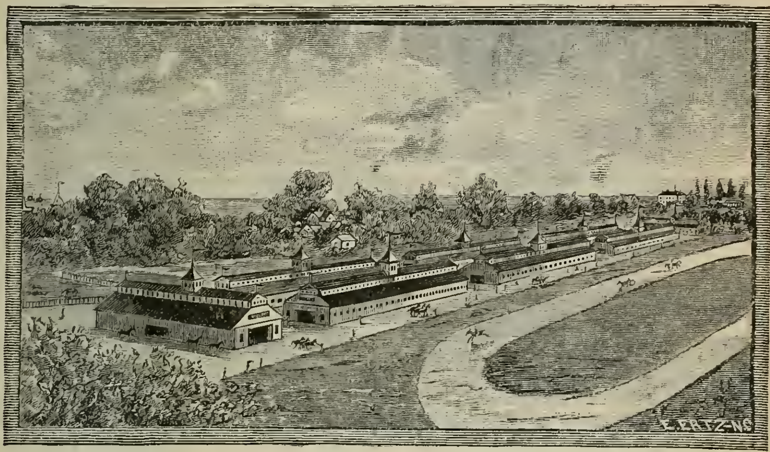
The Art Gallery was 250 feet long by 100 feet wide. It was a structure built of iron. The building was elegant and artistic, so arranged for hanging, accessibility, and light, as to present the best effects, and with ample accommodation for as large a collection as was ever exhibited on this hemisphere. It was fireproof, even the partitions being of iron.



The Factories and Mills Building.

Despite the enormous, and at first apparently extravagant size of the main building, it was found necessary to extend the machinery department. This extension, under the title of the Factories and Mills Building, was at first planned to be 350 by 120 feet, but was finally extended to 570 feet. It was made of iron, to contain the heavier machinery, and in it was especially shown cotton in all its processes of manufacture, and all the

newest appliances. Sugar cane and rice were also shown in all their stages of treatment and manufacture. Here was exhibited cotton from the boll to the bale, and the newly invented cotton pickers, openers, and lappers, as well as the various and complex machinery for ginning, cleaning, baling, and compressing, all in constant operation, a large supply of field cotton being provided for this purpose.



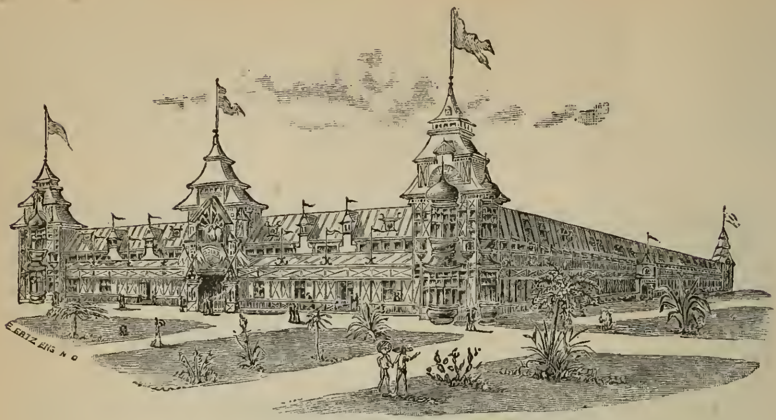
Live Stock Quarters, Stables, and Stock Arena.

The live stock quarters were unusually ample, situated in the northwestern portion of the park, towards St. Charles Avenue, and covered many acres of ground. There were six distinct buildings for horses and two for cattle. The buildings for horses were in two parallel rows, each 386 feet long, 60 feet wide, and 24 feet high. The stalls were arranged on either side—the heads of the animals to the outside, leaving a broad passage through the middle of the building. The buildings for the cattle stand at either end of the parallel rows, and at right angles with them. They were 378 feet long, 72 feet wide, and 24 feet high.

In addition to these live stock structures, a regulation half-mile track was laid out adjoining the line of buildings. The track and space inclosed was also used as an arena for the stock display.

The space devoted to the stock department was 2,080 by 780 feet, covering thirty-seven acres of ground.

Over $125,000 was appropriated by the management in encouraging, making provision for, and promoting the live stock display, a sum unequaled at any prior Exposition or industrial affair, the prime object having been to secure the most comprehensive, varied, and exhaustive representation of the stock interest of this continent that it was possible to do.



The Mexican National Headquarters.

The Mexican National Headquarters was built by the Mexican Government, from the design and under the supervision of their architect, Señor de Ybarrola, and brought to New Orleans for immediate erection. It was located in the southeast portion of the park. It was a triumph of taste and architectural achievement. A quadrangle 192 feet front by 288 feet deep, inclosed an open courtyard 115 feet by 184 feet, according to the general plan of a Mexican gentleman's residence, except that it had more entrances. Graceful towers at each corner and in the center of each side saved it from any accusation of straight line sameness, and gave ample chance for a wealth of florid ornamentation in the most Oriental style. The coloring, too, was ravishing, with its cunning conspiracies of gold and green and maroon, with touches of intense red here and there.

The interior gallery running round the courtyard was terraced, and here was placed a marvelous museum of the brilliant birds and fantastic flowers of Mexico, making a kind of hanging garden, enchanting to all beholders.

Altogether the most attractive feature of the Mexican representation was the octagon building, designed by Señor de Ybarrola, for the mineral display. This was located near the main building, in the most conspicuous part of the grounds, and was a specimen of the purest Saracenic architecture of the third epoch. Each face of the octagon was thirty-two feet wide, thus making an area of seventy-eight feet diameter, the whole supporting a wonderfully exquisite dome thirty feet high. It was built entirely of iron, a combination of columns and arches, with details of the most elaborate and delicate tracery. Viewed at a distance it gave the impression of being made of the finest and rarest point lace, and the dome, owing to a skillful arrangement of tints beneath the iron filagree, was made so light, so buoyant, so intangible, that it seemed not to rest upon but to be poised above the substructure. The spaces between the supporting columns were closed with panels of hard wood elaborately carved in Moorish designs, thus enabling the building to be closed or converted into an open air pavilion at will.

The troops sent over by the Mexican Government to take part in the Exposition were stationed in the headquarters' building.

Other Buildings.

Scattered over the grounds were a number of other buildings. That of the Grand Rapids furniture manufacturers was graceful and attractive. Several of the States had buildings of their own. North Carolina had two—one an office for its Commissioners, made of forty varieties of handsome native woods; the other a Chinese pagoda of mica, devoted specially to the exhibit of precious stones collected by the State. Similarly, other States had offices either for their Commissioners or for special exhibits; so, also, had the Territories, and a number of the towns and cities.

Sawmill Building.

The Sawmill Building stretched from the rear of "The Factories and Mills Building" towards the Mississippi. This was at first designated to be only 600 feet long, but its length was afterwards doubled. A wharf extended from this point into the river, where a boom of logs was provided for use in the fifty sawmills located here.

In addition to these were the several restaurants, lunch houses, and other edifices devoted to public comfort.

The following estimates of the cost of certain buildings were furnished to the State Mineralogist by the architect: The grand total cost for the construction of all the buildings erected by day's work, including plank roads and drainage of the park, amounted to $432,572. To this amount must be added the cost of material, probably amounting to about $400,000. The horticultural hall, art gallery, and machinery hall extension, were put up by contract, and cost together about $100,000; making a gross total of about $950,000.

There was no finish, strictly speaking, to any of the buildings at this Exposition, and no attempt at decoration beyond what was produced by the introduction of flags of all nations, large and small, and special devices of State or railroad headquarters. The woodwork was generally not even planed. In this feature the artistic effect of the Exposition fell far below those of other countries; but this defect was amply made up by the exhibits. The attendance was not large and fell below the number which had been reasonably expected. This was owing to several reasons, which may be briefly summed up as follows: The too recent exhibits of Atlanta, Louisville, and other American localities, and the international exhibits at Amsterdam and elsewhere in Europe; the unexpected difficulties which the management was called upon to overcome, which consumed valuable time and caused the impression to go abroad that the Exposition was a failure, while on the contrary it was a marked success, reflecting the greatest credit on the management. When this was at last admitted, the season was advanced and the weather too warm for comfort to Northern people. This, coupled with the idea that New Orleans was unhealthy after a certain season, prevented many Northern people from visiting the Exposition who otherwise would have been glad to do so.

The Exposition was opened December 16, 1884, with appropriate ceremonies.

At two o'clock on that day there were two hundred persons in the White House at Washington. In the center of the East Parlor a telegraph instrument was placed on a small table; an operator, Mr. Marean, sat at the table—below which stood the President of the United States, surrounded by members of his Cabinet, members of Congress, and promi-

nent men of the country. A telegram was received from President Richardson, of the Exposition, announcing the opening, and presenting the Exposition, through the President of the United States, to the people. The President's reply, declaring the Exposition open, was then returned to New Orleans. After this was read in the Main Building, the President, in Washington, with his own hand, gave the signal, by telegraph, upon which steam was turned on the great engine, and all the machinery was set in motion.

CALIFORNIA.

GEOGRAPHY.

California lies between 32 degrees 45 minutes and 42 degrees north latitude, and between the 38th and 48th meridian of longitude west of Washington. It is bounded on the north by Oregon, on the east by Nevada and Arizona, on the south by the Mexican State or Province of Lower California, and on the west by the Pacific Ocean. It has a seacoast 1,097 miles in length, and an average width of 200 miles. The area of the State approximates 156,000 square miles, or in round numbers, 100,000,000 of acres. Of this area 36,000,000 acres are specially suited to agriculture, 30,000,000 are grazing lands, also adapted to fruit raising; 20,000,000 are mountainous, but contain minerals of great value and timber; 5,000,000 acres are swamp or tule lands, which can, to a certain extent, be reclaimed; and 5,000,000 acres consist of alkaline lands or deserts, a portion only of which can be utilized. There are three principal chains of mountains in the State, nearly parallel to each other, and having the general trend of the coast. The Sierra Nevada is the backbone, so to speak. The rains falling on these mountains divide their waters at the summit, one portion flowing to the Pacific Ocean, the other finding its way eastward into the Great Basin, where it either sinks into the loose, sandy soil, or spreads out into alkaline lakes of considerable magnitude. These bodies of water are kept in a state of equilibrium by evaporation.

The Coast Range is rather a low range of mountains lying near the seacoast, as indicated by the name. In the southeastern part of the State there is another elevation which has been called the Inyo Mountains. This range differs from others mentioned in being highly argentiferous. Owens Valley, which separates it from the Sierra Nevada, is remarkable for its uniform width and great length, extending as it does for one hundred miles in a direction somewhat west of north. The mountain ridges lying both east and west of Owens Valley are the highest in the State, and some of the peaks or summits are the highest in the United States, if not in North America. Mount Whitney rises to an altitude of over 15,000 feet, and the summit may be reached without great difficulty. This celebrated mountain is surrounded by at least a hundred peaks, all of which are over 13,000 feet in height above the sea level. In the more southern portion of the State the mountains are broken into spurs, short ranges, and isolated buttes. It is to this portion of California that we look for a large output of silver in the near future. Other minerals and metals also abound in the irregular mountains mentioned.

The valleys of California vary from alpine meadows, surrounded by snow-clad inclines lying high up in the mountains, to widespread plains, between distant parallel mountain chains. All are fertile. Some require irrigation, others do not, while still others are improved by artificial watering.

There are several large lakes in the State and numerous lakes of lesser magnitude. Some contain pure and fresh water, while others are alkaline or salt.

FORESTS.

While some portions of California are well wooded, others are but sparsely covered with timber, while others still are entirely bare.

The Sierra, to an altitude of 8,000 feet, and some portions of the Coast Range, are clothed with magnificent forests of pine, fir, spruce, and cedar. Oaks do not appear at an altitude above 5,000 feet. The so called "big trees" of California—the Washington Cedar, or *Sequoia Gigantea* of the botanist—live only at a great altitude (from 5,000 to 8,000 feet), and not, as generally supposed, in two or three isolated spots, but in great abundance, extending for many miles along the line of altitude mentioned. They are too large to be conveniently handled, but the lumber and timber would be useful if it were accessible, which it practically is not. These trees seldom fall from natural causes, and when they do they lie from 800 to 1,000 years without material decay, like the granite or syenite obelisks left unfinished in ancient Egyptian quarries. These vegetable columns sometimes rise to an altitude of 400 feet, and in some cases measure forty feet in diameter at the base, although generally not more than thirty feet. Along the northern coasts grow the redwoods, from which a large portion of the lumber and timber in general use is obtained. These trees are also very large, some of them yielding from thirty to forty thousand feet of lumber. The wood is durable, easily worked, and has a straight grain and rich color. It is extensively used in California for building and other purposes, and is largely exported, latterly to London, where it is in great demand and commands fancy prices for ornamental purposes. Other useful and durable woods are found in abundance in the State.

SCENERY.

Our State is noted for its magnificent scenery. In the California Alps, the region surrounding Mt. Whitney, may possibly be found as superb landscapes and commanding views as at any locality on the face of the earth. This region of the State surpasses even the Yosemite and Hetch-Hetchy Valleys, celebrated the world over for their exceptional beauty and grandeur. Since visiting Mt. Whitney and the picturesque country in its vicinity, it has remained a mystery to me why tourists and lovers of nature in her grandest and wildest moods, do not flock to the locality and revel in its beauties.

Rugged mountain peaks of granite, partly covered with perpetual snow, mountain streams filled with trout, splendid cañons, wild rocky gorges, mountain meadows, lakes of purest water, cascades, cataracts, waters that "fall and pause and fall," mural cliffs rising to a dizzy height, dense and almost impenetrable forests, an atmosphere bracing and smelling of ozone, or redolent with the odor of fir balsam and pine needles, are a few of the attractions of the higher altitudes. Lower down are boiling springs, volcanic cones surrounded by extensive beds of ancient lava, and even a miniature Sahara with accompaniment of shifting hot sands and moving whirlwinds, alkaline lakes, and scattered sage-brush. Silver and gold mines may also be visited in the vicinity, the mountains are ribbed with undiscovered mineral wealth, and all of these attractions are within thirty miles or so of a well appointed narrow gauge railroad. Why all these natural beauties should go begging for appreciative observers, and not be eagerly sought by ubiquitous tourists, can only be accounted for by their ignorance of the facts I have here stated.

CLIMATE.

So much has been said and written of the climate of our State, that it is quite unnecessary to dwell upon the subject. As to temperature, almost any degree may be selected from a large assortment. It is only necessary to consider well what would be most agreeable, and then to seek it in the varying climes of Death Valley, the arenaceous plains of the Colorado or Mohave Deserts, among the snows and pines of the high Sierras, in the mountain valleys, in the fogs among the redwoods of the northern coast, or in the streets of Crescent City, San Francisco, Monterey, Los Angeles, or San Diego.

AGRICULTURAL RESOURCES AND PRODUCTS.

Thirty-five years ago agriculture was almost unknown in California. Now it is the mainstay of State industries, both present and prospective. The adverse opinion I have formed as to the policy of raising enormous crops of cereals in California, to send abroad, discounting the future, so to speak, by extracting from our fertile soil the elements of that fertility and sending it out of the country, may be erroneous, but I fear not. The facts, however, remain.

The average annual production of cereals for the last five years, may be seen by the following estimate:

Wheat, 45,000,000 bushels, value	$50,000,000
Barley, 10,000,000 bushels	7,000,000
Oats, 3,000,000 bushels	2,000,000
Rye, 300,000 bushels	200,000
Buckwheat, 5,000 bushels	5,000

The annual shipment of wheat and flour from San Francisco amounts to about 1,250,000 tons, of the aggregate value of nearly $40,000,000. 1,250,000 barrels of flour are made from the wheat crop by 200 flouring mills in the State, of which 120 are steam, while 80 are driven by water. The yield of the cereal crop is from 20 to 30 per cent higher in California than in States east of the Mississippi River, and there has never been a general failure of this crop in this State.

Almost every kind of vegetable can be grown in California, in some localities without, and in nearly all parts of the State with irrigation. Under favorable circumstances they grow luxuriantly, some of the vegetables raised in our State having been noted for their large size. Thus we have produced squashes of good quality weighing 260 pounds each, 800 pounds, in one instance, having been raised on a single vine. We have grown cabbages weighing 50 pounds; beets weighing 118 pounds; watermelons weighing 110 pounds; and carrots, turnips, and other vegetables of corresponding size.

The number of fruit trees in the State is roughly estimated at 8,000,000, divided as follows: Apple, 2,700,000; peach, 1,200,000; pear, 500,000; plum and prune, 600,000; cherry, 400,000; apricot, 500,000; orange, 1,600,000; lime and lemon, 500,000. Aside from this estimate there are several hundred thousand fig trees, olive, quince, and other fruit-bearing trees, not to mention a vast number of currant and berry bushes of every description. The fruit crop is never wholly gathered, large quantities going to waste every year. Some of the surplus is dried and canned, and thus saved from loss.

The horned cattle of California now number 800,000 head—one third of the number in the State thirty years ago; but those remaining are of im-

proved breeds, a considerable portion being kept for dairy purposes, whereas formerly cattle were only valued for their hides and tallow.

Dairying is extensively conducted in California. For a number of years the production of butter alone has been estimated at 11,000,000 pounds, and of cheese at 4,000,000 pounds.

It is estimated that there are 5,000,000 sheep in the State. The wool clip is approximately 40,000,000 pounds, of an estimated value of $8,000,000.

Grapes and Wine.—Certain extensive areas in California are specially adapted to the culture of the grape. The wines are not only good, but the product is generous. Mr. Wetmore, a California authority on the subject, estimates that in 1885, 70,000 acres of vines were in bearing. The vintage for 1881 was 12,000,000 gallons; in 1882 it was 9,000,000 gallons; in 1883, 9,500,000 gallons. I have not convenient data for more recent production.

Honey.—There are 1,000 bee-keepers in the State, and 100,000 colonies of bees. Each colony produces 200 pounds of honey annually, or 20,000,000 pounds in all. Of wax, each colony yields five pounds, or an aggregate of 500,000 pounds. The value of the wax, at 25 cents per pound, amounts to $125,000. The honey is of the best quality, and is largely exported to Germany, Glasgow, Paris, and Liverpool, the bulk of the export going to the latter port. Most of the honey so exported is first extracted from the comb.

All of the agricultural products of California were well represented at the Exposition, the effect of which must and will be felt, and will in all probability cause immigration of the better classes to our State.

San Francisco, our principal city, is destined to become one of the largest and most important in the world. From Acapulco, in Mexico, to the Straits of Fuca, there is no other perfect harbor. Here a ship can be sailed in without a pilot. San Francisco is as well situated for a manufacturing as for a commercial port. The climate is such that laborers and mechanics, artisans, etc., can work every day in the year without discomfort, there being no extremes of heat and cold. A noble, navigable bay, without impediments, extends east and south many miles from San Francisco. The shores of the bay are already settled, and villages and garden grounds extend on every side. To the east lie the western and middle States and Territories; to the south, Mexico, Central and South America; to the north, Oregon, Washington Territory, British Columbia, and Alaska; to the west, and beyond the Golden Gate, is the broad Pacific, a roadway to China, Japan, the Indies, and Australia, and to the Islands of the South Seas.

HISTORY.

Events resulting from the advance of civilization, within the historic period, have operated slowly but continuously toward the settlement of the American continent. What may have happened before the birth of history is unknown to us, or we can only glean traces of the past from geological study, and contemplation of silent ruins left by unknown races. To the thoughtful student of prehistoric relics a singular line of inquiry is suggested. The remains of the ancient civilizations of Chili and Peru appear to antedate other American ethnological records, and have a curious correspondence to the earliest traces of human life in Europe and Asia. It is even possible, and perhaps probable, that this continent was the birthplace of civilization, and that Asia and Europe were peopled from America by way of Behring's Straits, in the north, or, still more likely, that boatloads of people drifted across the Pacific before the trade winds from the coast of Peru, as ably argued by Charles Wolcott Brooks, of San

Francisco, in a valuable paper read before the California Academy of Sciences. Be this as it may, in compiling a brief history of California we must confine our investigations within the bounds of written history.

It is curious to consider the influence of nature's laws in shaping the acts and destiny of man. The revolution of the earth on its axis produces the trade winds, and causes the phenomena of the tides. The trade winds, blowing always from the east, make it easier to sail westward than to return. Hence, "Westward the star of empire takes its way." The inclination of the axis of the earth to the plane of its orbit causes the change of seasons, and renders one part of the earth more desirable than another as a place of residence. Not only do the trade winds make it possible to sail safely for long distances westward, but in many cases vessels have been forced to sail before them when blown from an eastern shore. Posidonious, as quoted by Strabo, writes: "Starting from the west, one might, aided by a continual east wind, reach India in so many stadia."

The Chinese are supposed to have been the earliest sailors, and are accredited with the discovery of the magnetic needle, which was first a bit of loadstone, floated on a chip in a vessel of water. The Chinese had large ships before the birth of Christ, and so also had the Carthagenians and Phœnicians.

The first ventures made by men living near the shores of the sea were fishing voyages in canoes, or on logs, rafts, or catamarans. From this the next step was to canoes, cut from logs of great size, capable of carrying many men, such as are now used by the South Sea Islanders. When these were not long enough, composite vessels were built in which pieces of timber were fastened together, but which were still impelled by oars. Sails were first used to assist the oars in propelling the primitive ships. As the art of building ships improved, longer voyages were undertaken, and sailors became more venturesome, but still followed the coast from cape to cape or from island to island. Pytheas, a native of Masilia, explored the Baltic and sailed to the north, passing Great Britain and Scotland and reaching Thule. The island to which this name was given may have been Iceland or the Shetland Islands. As explorers extended their navigation to the south, by the way of the Red Sea, and west in the Mediterranean, they came at last to the Pillars of Hercules, now the Straits of Gibraltar, or to Bab El Mandeb, the gate to the Red Sea, face to face in each case with a great unknown ocean. Coasting north in the former instance they reached Britain, and sailing south in the latter they entered the Indian Ocean, and discovered and fully explored Madagascar and the eastern coast of Africa, now thought to be the Ophir of Solomon. Sailing east, they found ports in Arabia and India. They doubled the Cape of Good Hope and probably visited Central and South America and the West India Islands. The ancients knew that the earth was a sphere. Pythagoras showed his pupils that our planet cast a circular shadow on the moon in the time of an eclipse. The Greek philosophers taught that the earth was a sphere and mentioned antipodes.

In an old book (*American Antiquities and Discoveries in the West*, by Josiah Priest, Albany, 1835), I find a quotation, showing that in 1821 a planter living near Montevideo, in Uraguay, South America, found in a field a tombstone upon which Greek characters were inscribed. This stone was raised, and a shield, helmet, and swords were found beneath, and an earthern vessel or amphora. The Greek inscription, with the exception of a portion, which was nearly obliterated, translated thus: "During the dominion of Alexander, son of Philip, King of Macedonia, in the sixty-third Olympiad Ptolemais * * *." On the helmet was a design representing

Achilles dragging the corpse of Hector around the walls of Troy. In the private collection of President Soto, of Honduras, exhibited in the California State Museum in 1883, a sculptured sphynx was shown. This would indicate that the ancient people of Copan were at least in communication with those of Europe. The universal custom of erecting tumuli must have had a common origin with a similar practice in ancient Europe and Asia.

The Greeks thought that in the north, ice and snow would put a bar to navigation, and in the south the heat would become so great as to melt and burn any ship or people, and to the west the sea would grow shallow or change to a morass, where Atlantis sank. Plato believed that mariners could sail east or west, and either return to the same point or meet with unknown continents. He asserted that the fabled Continent of Atlantis was greater than Europe and Africa combined. Virgil had heard of a western land; Tibullus of another world in the great ocean, and declared that it would be possible to sail from Spain to India, were not the Atlantic Ocean so wide. The fable of Atlantis was probably based on the stories of returned voyagers from America. The "Islands of the Blessed," lying to the west, mentioned by Strabo, historian and writer, are thought to be the Canary Islands, but possibly were the West Indies. The Romans sailed to Britain in the time of Cæsar. Agricola, Governor of Britain, in the time of the Emperor Vespasian, sent a fleet westward through the Pillars of Hercules, which sailed around Britain, and "saw Thule from afar."

California, although one of the younger States of the American Union, is old in history. Seventy-eight years before the Mayflower landed her load of pilgrims in Massachusetts, and forty-three years before Sir Walter Raleigh attempted a settlement on Roanoke Island, Upper California had been discovered, and it was settled and missions established within its borders before the Revolutionary War.

The word California first appears in the writings of Bernal Dias Costello, companion and historian of Cortez. Its origin is unknown. Michael Venegos, in his *Natural and Civil History of California*, published in 1758, expresses the opinion that the name was derived from an accidental word or misunderstood Indian name.

The following chronological events led ultimately to the discovery of California:

982. Eric the Red, a Norman, visits Greenland.
985. Bjorn Heriulfsson, also a Norman, sighted the coast of Labrador.
1000. Leif, also a Norman, visited Vinland.
1035. Frisians sail from the Weser to the north.
1147. Arabs sail from Lisbon into the great ocean.
1170. Madoc sails westward from Wales.
1284. Vivaldi and Dorea sail from Genoa into the ocean.
1280.–1295. Marco Polo travels in China and Japan.
1326. Spaniards visit the Canary Islands.
1420. Island of Madeira discovered by the Portuguese.
1432. Azores Islands visited by the Portuguese.
1446. Cape De Verde Islands discovered by the Portuguese.
1486. Bartholoma Diaz reaches the southern cape of Africa.
1492. August third, Columbus sails from Palos, Spain, westward to discover the Indies.
1513. The Pacific Ocean was discovered by Balboa.
1523. Charles V assisted Cortez to search for a strait to the Spice Islands.
1534. Lower or Old California was discovered by Fortun Ximenez, a commander or pilot under Cortez, or by Hernando de Grixalva, in the month of February of that year.
1535. Cortez coasted both sides of the Gulf of California with four hundred Spaniards and three hundred negro slaves.
1541. California was known as a peninsula, but this discovery was forgotten for over a hundred years, during which period it was thought to be an island, and was called "Islas Carolinas."

1542. Juan Rodriguez Cabrillo sailed along the northwest coast of America. He discovered Upper or New California, and sailed as far north as Cape Mendocino.
1553. New Mexico was discovered. The Spaniards introduced agriculture, and worked some rich mines near Santa Fe.
1579. Sir Francis Drake discovered the coast of Upper California, which he named New Albion.
1587. Captain Thomas Cavendish fell in with Cape St. Lucas, and soon after captured the annual Spanish galleon.
1596. Gaspar de Zunega, Count de Monte Rey, was ordered to make explorations of the coast of California.
1683. Expedition ordered by Court of Spain. Command given to Don Isodoro Otondo. Father Kuhn or Kino was made spiritual commander. He rediscovered the fact that California was not an island.
1697. The Jesuits asked permission of the Crown to make spiritual conquests in California.
1708–9. Captain Woodes Rogers sailed from England and touched at some uncertain port in California.
1741. The Russians advanced seven hundred and twenty miles southward from Cape Mendocino.
1743. Spanish galleon touched for the first time at the Port of Cape St. Lucas.
1746. The Jesuit, Fernando Consag, explored the Gulf of California.
1747. The Jesuits had established forty-three missions in California.
1767. The Jesuits were expelled from California.
1769. The Mission of San Diego was founded by Junipero Serra.
1769–70. The missionaries, in extending their spiritual explorations, journeyed northward, and in December, 1769, or January, 1770, discovered a great bay, which they named San Francisco, from their patron saint.
1776. The Mission of San Francisco was founded. A supply ship, which arrived August eighteenth, was probably the first vessel to enter the Golden Gate.
1812. The Russians took possession of Bodega Bay, and subsequently of Fort Ross.
1841. During this year the Russians abandoned Fort Ross and sold the property to Captain John A. Sutter.
1846. In January of this year, Colonel John C. Fremont arrived at Monterey. In May, General Taylor crossed the Rio Grande, and war was commenced in Mexico. July fourth, Fremont called a meeting of citizens of Sonora, who asserted California's independence, and declared war against Mexico. On the tenth of July the American flag was hoisted at Monterey and San Francisco.
1847. California was ceded to the United States on payment of $15,000,000. On the sixth of March, the ship "Thomas H. Perkins" arrived with a portion of Stevenson's regiment. The war with Mexico was already ended.
1848. January nineteenth Marshall discovered gold at Sutter's Mill. The treaty of Guadalupe Hidalgo was signed at this time.
1849. February twenty-eighth, the first steamer that ever entered the Golden Gate, the "California," arrived at San Francisco.
1850. California was admitted to the Union, and became a State.

Californians have been unjustly accused of making exaggerated statements when speaking of the varied resources and the climate of their State. We were, ourselves, surprised when we became aware of the value and importance of the land we had selected for our abode. We came to the New El Dorado to dig in the placers for gold. We remained to make homes and to develop resources little suspected by the peaceful invaders who swarmed like locusts on the golden shores. We thought the country fit only for mining, until, almost by accident, was discovered fertility in the soil, and its fitness for agriculture proved. As a reward for their industry and foresight, the pioneer farmers were soon enabled to sell to the miners, at exorbitant prices in yellow gold, the finest vegetables and fruit. They imported bees and set them to work gathering sweets from the beautiful wild flowers of California, and the stores of honey these industrious insects laid up was a new surprise. Fields were sown with wheat and other cereals, which yielded handsome returns. Fruit trees, experimentally set out, rewarded the planters with abundant crops in the course of a few years. In the meantime we made salt, burned lime, made bricks, erected sawmills, tried our hand at wool manufacture, built a few miles of railroad, and, in a word, as far as we were able, or could spare time from mining, endeavored to supply our growing wants from the native resources of the State.

During the first few years, the yield of gold did not materially diminish, but farming greatly increased, and the agricultural districts gradually rose in importance, until our noble bay was crowded with ships from foreign lands, which bore away to hungry Europe our enormous surplus crops of wheat. Wool and wine became, also, important factors in the general prosperity of the State.

CALIFORNIA MINERAL EXHIBIT IN THE GOVERNMENT BUILDING.

The total area occupied by the collective exhibits of California was 14,450 square feet of ground-floor, and a portion of the gallery with an additional space of 2,550 square feet. The space set aside for our State was larger than for any other except Texas. It is a pleasure to state that all the space was filled, and creditably filled, with the varied resources of California. The space devoted to the State mineral collection was near the State headquarters, on both sides of the entrance. It was so arranged that persons having business or visiting the official department passed between rows of plate-glass museum cases, the number of and the general arrangement of which have been mentioned before. The collection was classified into four groups—ores, minerals, rocks, and manufactures.

Many persons are under the impression that gold, silver, copper, and quicksilver, make up the sum total of the mineral products of California; this is a mistake; other valuable and useful minerals are abundant.

In the last report of this office (Fourth Annual Report of the State Mineralogist for the year ending May 15, 1884), a catalogue of all the distinct mineral species known to exist in California, was published; the number described was one hundred and sixty-one. Varieties were described but not numbered. The following is a classified list of the species. The numbers are those of the fourth annual report:

Arseniates.

57. ERYTHRITE. Etym. *Red* (Greek). Arseniate of Cobalt.
83. LEUCOPYRITE. Etym. *White* (Greek), and *Pyrite;* Arsenical Iron.

Antimoniate.

18. BINDHEIMITE. Etym. "*Bindheim,*" the chemist who first analyzed it. Hydrous antimoniate of lead, or a compound of the oxides of the two metals; the antimony oxide acting as an acid, the lead as a base.

Borates.

21. BORATE OF STRONTIA. Mentioned in letter written by Dr. John A. Veatch to the California Borax Company, quoted in full in the Third Annual Report, Part 2, Fol. 15.
22. BORAX. Etym. *Boorak*, or *Baurach* (Arabic), Bi-borate of Soda, Tincal, Native Borax, etc.
112. PRICEITE. Etym. *Price*, San Francisco chemist. Pandermite is a variety of priceite. Colemanite is also a variety of priceite.
154. ULEXITE. Borate of Lime, Tiza, Boronatrocalcite, Natroborocalcite, Tinkalzit, Cotton Balls, Sheet Cotton, etc. Named from Ulex, a noted chemist.

Carbonates.

9. ARAGONITE. Etym. *Aragon*, a province in Spain. Carbonate of Lime.
15. AZURITE. Etym. *Azure, a blue color.* Mountain Blue, Blue Malachite, Chessy Copper, Azure Copper Ore, etc. Hydrous Carbonate of Copper.
20. BISMUTITE. Etym. *Metal Bismuth.* Hydrous Carbonate of Bismuth, Stream Bismuth.
26. CALCITE. Etym. "*Calx*"—lime (Latin). Carbonate of Lime, Calcareous Spar, Calc Spar, Dogtooth Spar, Iceland Spar, Limestone, Lithographic Stone, Marble, Stalactite, Stalagmite, Travertine, Tufa, Thinolite, Anthraconite, etc.
30. CERUSITE. Etym. *Cerussa* (Latin). White Lead, Carbonate of Lead, White Lead Ore, etc.
47. DIALLOGITE. Etym. *doubtful* (Greek). Rhodochrosite, Carbonate of Manganese.

50. DOLOMITE. Named from the French geologist Dolomieu. Carbonate of Lime and Magnesia.
62. GAY-LUSSITE. Etym. *Gay-Lussac*, French chemist. Carbonate of Lime and Soda.
73. HYDROMAGNESITE. Hydrous Carbonate of Magnesia.
87. MAGNESITE. Etym. *Magnesia* (Greek). Carbonate of Magnesia.
89. MALACHITE. Etym. "*Mallow*." Green Carbonate of Copper, Mountain Green.
134. SIDERITE. Named from the Latin word for Loadstone, or Magnet. Spathic Iron, Carbonate of Iron.
136. SMITHSONITE. Carbonate of Zinc.
152. TRONA. Etym. Egyptian name. Sesquicarbonate of Soda.
158. ZARATITE. Named from a Spaniard. Emerald Nickel, Hydrate of Nickel, Hydrated Carbonate of Nickel.

Chlorides.

14. ATACAMITE. Etym. "*Atacama*," a province in Bolivia. Chloride of Copper.
29. CERARGYRITE. Etym. "*Horn Silver*" (Greek). Chloride of Silver.
70. HALITE. Etym. *Salt* (Greek). Common Salt, Chloride of Sodium.

Chloro-bromide.

52. EMBOLITE. From a Greek word, meaning intermediate. Chloro-bromide of Silver.

Chloro-carbonate.

108. PHOSGENITE. Etym. *Phosgene*, Light Producer. Chloro-carbonate of Lead.

Elements.

11. ARSENIC. Etym. *Arsenicum* (Latin). See also Arsenolite.
40. COPPER. Etym. *Cuprum* (Lat.).
48. DIAMOND. Crystallized Carbon. The name diamond is a corruption of "adamas" or "adamant," derived from two Greek words, meaning "I conquer."
36. GOLD.
67. GRAPHITE. Etym. "*I Write*" (Greek). Plumbago, Black Lead, etc. Graphite, when pure, consists of carbon.
74. IODINE. Etym. *Violet* (Greek).
75. IRIDIUM. Etym. *Rainbow* (Latin).
95. IRON, METEORIC.
102. NICKEL. In meteoric iron.
110. PLATINUM. Etym. *Plata*, Silver.
122. QUICKSILVER. Etym. "*Living Silver*." Mercury.
135. SILVER.
143. SULPHUR. The term sulphur is derived from the Latin word *sal* (salt), and the Greek for fire.
146. TELLURIUM—See also Altaite, Calaverite, Hessite, Petzite, and Tetradymite.

Fluoride.

59. FLUORITE. Etym. *To Flow* (Latin). Fluorspar, Fluoride of Calcium.

Iodide.

39. COCCINITE. Iodide of Mercury.

Molybdate.

157. WULFENITE. Molybdate of Lead.

Nitrate.

137. SODA NITER.

Oxides.

12. ARSENOLITE. Etym. "*Arsenicum*" (Latin). Oxide of Arsenic.
27. CASSITERITE. Etym. "*Tin*" (Greek). Binoxide of Tin.
31. CERVANTITE. Etym. "*Cervantes*" (Span). Antimony Ochre.
35. CHROMITE. Etym. "*Color*" (Greek) impure oxide of chromium. Chromic Iron, Chrome Ore, etc.
42. CORUNDUM. Etym. *Kurand* (Hindoo). Oxide of Aluminum.
44. CUPRITE. Etym. *Cuprum*, copper (Latin). Red Oxide of Copper.
71. HEMATITE. Etym. *Blood* (Greek). Hæmatitis, Specular Iron, Micaceous Iron, Red Hematite, Susquioxide of Iron.
84. LIMONITE. Etym. *Meadow* (Greek). Hydrous Sesquioxide of Iron.
85. LITHARGE. Etym. *Silver Stone* (Greek). Oxide of Lead.
88. MAGNETITE. Etym. *Magnesia Stone* (Greek). Magnetic Iron Ore.
92. MELACONITE. Etym. *Black* (Greek). Black Oxide of Copper.

93. MENACCANITE. Etym. *Menaccan*, in Cornwall, England. Ilmenite, Titaniferous Iron.
101. MOLYBDITE. Molybdic Acid, Molybdic Ochre.
103. OPAL. Etym. *Opalus* (Latin). Hyalite, Wood Opal. Silicic Acid, Oxide of Silicon.
109. PICOTITE. Etym. *Picot de la Peyrouse*, French chemist. Chrome Spinel.
114. PSILOMELANE. Etym. *Bare* and *Black* (Greek). Oxide of Manganese.
116. PYROLUSITE. Etym. *Fire-wash* (Greek). Binoxide of Manganese.
121. QUARTZ. Oxide of Silicon, Silicic Acid, Silica.
128. RUTILE. *Rutilus*, Red (Latin). Titanic Acid.
130. SASSOLITE. Native Boracic Acid.
140. STIBICONITE. Partzite, Antimony Ochre, Hydrous Oxide of Antimony.

Organic.

17. BERNARDINITE. (?) Etym. *San Bernardino County, California.*
98. MINERAL COAL. Lignite, Anthracite, Ionite, etc.
106. PETROLEUM.
124. RESIN. Fossil.

Phosphate.

156. VIVIANITE. Etym. Vivian, an English mineralogist. Phosphate of Iron.

Silicates.

1. AGALMAMOLITE. Etym. "*An Image*" (Greek). Pagodite—from *Pagoda* (Chinese). Chinese figure stone, a variety of pinite, hydrous silicate of alumina, magnesia, iron, lime, soda, and potash.
2. ALBITE. Soda Feldspar. Etym. *Albus* (white), from its color. Silicate of alumina and soda.
5. AMPHIBOLE. Etym. "*Doubtful*" (Greek). Actinolite, Anthophyllite, Amianthus, Asbestus, Hornblende, Mountain Cork, Mountain Leather, Tremolite, etc.
6. ANDALUSITE. Named from Andalusia, a province in Spain, where it was first found, is a silicate of alumina, containing sometimes sesquioxide of iron, magnesia, lime, soda, potash, and manganese in varying proportions.
19. BIOLITE. Etym. *Biot*, French physicist, who first studied its crystallography. Hexagonal Mica. See, also, Mica.
36. CHRYSOCOLLA. "*Gold Glue*" (Greek). A hydrous Silicate of Copper.
37. CHRYSOTILE. This is a magnesian mineral, a variety of serpentine.
38. CLAY. Hydrated silicate of alumina, contaminated, more or less, by various impurities, mechanically intermixed.
46. DATOLITE, OR DATHOLITE. Etym. "*To Divide*" (Greek). Silicate of lime, containing from eighteen to twenty-two per cent of boracic acid.
54. ENSTATITE. Etym. *An Opponent* (Greek). Bronzite, Silicate of Magnesia, Alumina, Iron, Lime, Manganese, etc.
55. EPIDOTE. Etym. *Increase* (Greek). Silicate of Alumina, Lime, Iron, etc.
58. FELDSPAR—See also Albite, Labradorite, and Orthoclase. The name Feldspar generally applies to *Orthoclase*, but it also indicates a group of minerals, called the feldspar group.
61. GARNET. Etym. *Pomegranate Seeds* (Latin). Andradite.
65. GLAUCOPHANE. Etym. *Glaucus*, sea-green color (Latin). Wichtisite. This mineral occurs in a rock matrix, widely distributed in California, and associated with serpentine.
68. GROSSULARITE. Etym. *Gooseberry* (Latin). Lime Garnet.
78. JEFFERISITE. Named from *Jefferis*, mineralogist, of Pennsylvania.
79. LABRADORITE. Etym. *Labrador.* Feldspar.
81. LENZINITE. Hydrous Silicate of Alumina.
82. LEPIDOLITE. Etym. *Scale Stone* (Greek). Lithium Mica.
86. LITHOMARGE. Etym. *Marl Stone* (Greek and Latin). Fine grained Hydrous Silicate of Alumina.
90. MARIPOSITE. *Spanish*, a butterfly. *Mariposa County.* (Provisional name.)
96. MICA. Etym. "*A Crumb* or *Grain*" (Latin). Isinglass, Muscovy Glass, etc. This name is not confined to a single mineral, but is applied to a group, the members of which are silicates of a variety of bases; all having a cleavage parallel with the base of the crystal.
104. ORTHOCLASE—See also Feldspar—Common Feldspar, Potash Feldspar. This mineral derives its name from the Greek, meaning "*straight break*," because it cleaves at right angles. It is a silicate of alumina and potash.
105. PECTOLITE. Etym. *Combstone* (Greek).
119. PYROPHYLLITE. Etym. *Fire Leaf* (Greek).
120. PYROXENE. Etym. *Stranger to Fire* (Greek). A silicate of different bases, the varieties of which are known under different names, as augite, diopside, sahlite, omphazite, hypersthene, diallage, smaragdite, etc.
125. RHODONITE. Silicate of Manganese. Named from its red color, from a Greek word, "the rose."
126. ROCK SOAP. This is a mineral resembling halloysite and mordenite, but believed to be a mechanical mixture of two or more minerals. It has the remarkable property of removing impurity from the skin, like soap.

132. SEPIOLITE. Meerschaum, Hydrous Silicate of Magnesia.

133. SERPENTINE. Chryotile, Picrolite, Retinalite. So called from its resemblance to the skin of a serpent, is found in such large masses or beds that it is also classed with the rocks.

145. TALC. Steatite, Soapstone, French Chalk.

150. TITANITE. Sphene, Titaniferous Iron. Named from Titanium, one of the elements. Sphene is from the Greek for a wedge, from the shape of its crystals.

151. TOURMALINE. Is a mineral almost invariably found crystallized, of all colors, from opaque black to nearly or quite transparent colorless. The usual colors are: *black* (schorl), *red* (rubellite), *blue* (indicolite), *green* (crysolite), *honey-yellow* (peridot), *colorless* (achroite).

155. VESUVIANITE. Etym. *Vesuvius.* Idocrase. Silicate of alumina, lime, iron, etc., first found in the ancient lavas of Vesuvius, whence the name.

159. ZEOLITE. Etym. *Boil* and *Stone* (Greek). The name zeolite applies to a group of minerals which includes at least twenty species; the name is therefore indefinite. They are all hydrous silicates of alumina, and generally are found in lavas and amygdaloids.

161. ZIRCON. Jargon, Silicate of Zirconia.

Sulphates.

4. ALUM. Etym. "*Alumen*" (Latin), as generally understood, is a hydrous sulphate of alumina and potash.

7. ANGLESITE. Etym. "*Anglesea*," an island on the coast of Wales. Is a natural sulphate of lead, called also "lead vitriol."

8. ANHYDRITE. Etym. "*Without Water*" (Greek). Anhydrous Sulphate of Lime, Anhydrous Gypsum.

16. BARITE. Etym. "*Heavy*" (Greek), Barytes, Sulphate of Baryta, Heavy Spar, Terra Ponderosa, Cawk, and many other names. The element Barium is named from this mineral. The term *Terra Ponderosa* was applied by the earlier chemists and mineralogists.

32. CHALCANTHITE. Etym. "*Flowers of Copper*" (Greek). Native Sulphate of Copper, Blue Vitriol.

41. COPPERAS. Etym. *Cuprosa* (Lat.), Coquimbite, in part Hydrous Sulphate of Iron.

56. EPSOMITE. Epsom Salt, Hair Salt, Sulphate of Magnesia.

64. GLAUBERITE. Etym. *Glauber*, German chemist. Sulphate of lime and soda.

69. GYPSUM. Ancient name—Alabaster, Selenite, Satin Spar, Plaster of Paris.

153. TURBITH MINERAL. Yellow Sulphate of Mercury. Is not found in nature. Specimens taken from the interior of the furnaces at the Sulphur Bank quicksilver mine, Lake County.

Sulphides.

10. ARGENTITE. Etym. "*Argentum*" (Latin name for silver). Silver Glance, Vitreous Silver, Sulphuret of Silver.

13. ARSENOPYRITE. Etym. *Arsenic and Pyrite.* Mispickel.

23. BORNITE. Etym. *Born*, a chemist of the last century. Purple Copper Ore, Variegated Copper, Horseflesh Ore, Erubescite, etc. Is a double sulphide of copper and iron.

33. CHALCOPYRITE. Etym. "*Copper Pyrite*" (Greek). (See, also, Copper.) Copper Pyrites. This mineral is also a double sulphide of copper and iron.

34. CHALCOSITE. Etym. *Copper* (Greek). Vitreous Copper, Copper Glance. Sulphide of Copper.

43. CUBAN. Etym. *Cuba.* Sulphide of Copper and Iron.

51. DUFRENOYSITE. Etym. *Dufrenoy*, French mineralogist. Composed of Sulphur, Arsenic, and Lead.

60. GALENA. Etym. *Lead Ore, or Lead Dross* (Latin). Galenite. See, also, Lead. Sulphide of Lead.

63. GEOCRONITE. Etym. *Earth* and *Saturn*, the alchemistic name for Lead (Greek). Sulphide of Lead and Antimony.

77. JAMESONITE. Named from *Jameson*, Scotch geologist. Sulphide of Antimony, Lead, Iron, Copper, and Zinc.

91. MARCASITE. Etym. ancient name for *Pyrite* (Arabic, or Moorish origin). Sulphide of Iron, White Pyrites.

94. METACINNABARITE. Etym. *Beyond* (Greek) and *Cinnabar*). Black Sulphide of Mercury.

97. MILLERITE. Sulphide of Nickel.

100. MOLYBDENITE. Etym. *Lead* (Greek). Sulphide of Molybdenum.

117. PHYRRHOTITE. Etym. *Reddish* (Greek). Magnetic Pyrites.

111. POLYBASITE. Named from the Greek—*Many Bases*—it being a sulphide of many bases, viz.: antimony, arsenic, copper, iron, silver, and zinc.

113. PROUSTITE. Etym. *Proust*, French chemist. Light Ruby Silver Ore. Arsenical Sulphide of Silver.

115. PYRARGYRITE. Etym. *Fire Silver* (Greek). Dark Ruby Silver, Antimonial Sulphide of Silver.

118. PYRITES. Etym. *Fire* (Greek). Pyrite, Sulphuret of Iron, the "Sulphurets" of the gold miner, Mundic, Martial Pyrites. See, also, Marcasite.

123. REALGAR. Name used by the alchemists. Sulphide of Arsenic.

138. SPHALERITE. Blende, Zinc Blende, Black Jack, Sulphuret of Zinc. The name

"sphalerite" is from the Greek, meaning treacherous. The original name "blende" is from the German, meaning blind, deceiving, because blende while resembling galena produced no lead.

139. STEPHANITE. Etym. *Stephan*, Mining Director of Austria. Brittle Silver Ore, Brittle Sulphuret of Silver. This is a double sulphide of silver and antimony.

141. STIBNITE. Etym. *Stibium* (antimony). Sulphide of Antimony, Antimony Glance.

142. STROMEYRITE. Etym. *Stromeyer*, chemist who first analyzed it. Silver Copper Glance.

148. TETRAHEDRITE. Name for tetrahedron. Gray Copper, Fahlerz, Sulphide of Copper and Antimony.

Sulpho-Arsenide.

53. ENARGITE. Etym. *Obvious* (Greek), sulpho-arsenide of copper, sometimes containing antimony, iron, silver, or zinc.

Tellurides.

3. ALTAITE. Etym. *Altai Mountains of Asia.* Telluride of Lead.
25. CALAVERITE. Etym. *Calaveras County*, where first found.
72. HESSITE. Etym. *Hess*, Russian chemist. Telluride of Silver.
107. PETZITE. Etym. *Petz*, the chemist who first analyzed it.
A variety of Hessite, being a telluride of silver and gold—the latter metal replacing part of the silver.
144. SYLVANITE. Etym. *Transylvania.* Telluride of Gold.
147. TETRADYMITE. Etym. *Quadruple* (Greek). Bismuth, with Tellurium.

Tungstates.

45. CUPROSCHEELITE. Tungstate of Lime and Copper.
131. SCHEELITE. This mineral is named after the Swedish chemist Scheele. It is a Tungstate of Lime.

Vanadate.

127. ROSCOELITE. Named from Prof. Roscoe of Manchester, England; contains 28.6 per cent of vanadic acid.

Sundries.

24. BUILDING STONES.
28. CEMENT.
49. DIATOMACEOUS EARTH.
76. IRON ORES. See, also, Hematite, Limonite, and Magnetite.
80. LEAD ORES. See, also, Galena, Anglesite, and Cerusite.
99. MINERAL WATERS.

Since the publication of the last annual report, a new California mineral has been discovered. The following papers, which are given in full, contain all at present known of this interesting mineral:

ON HANKSITE.

A New Anhydrous Sulphato-Carbonate, from San Bernardino County, California.

By William Earl Hidden.

[From the Annals of the New York Academy of Sciences, Vol. III, No. 7. Read May 25, 1885.]

In the very complete and attractive exhibit of California minerals brought to the World's Industrial and Cotton Centennial Exposition at New Orleans, by Henry G. Hanks, State Mineralogist of California, were several species of unusual interest.

Among these, was the new borate, Colemanite, with its large and lustrous crystals so much resembling the finest of the Bergen Hill datolites; the new vanadium mica, Roscoelite, mixed as it is mechanically with much native gold between its folia; borax crystals, clear and bright, of unusual size; stibnite in superb crystals almost equaling the late discoveries in this species in Japan, and many others equally noteworthy, and to which I may refer in a separate paper later.

Of particular interest to the writer was a small lot of *apparently hexag-*

onal crystals to which had been given the name of "Thenardite." Now as Thenardite is asserted in the text-books to be orthorhombic, I was prompted to measure the angles of these crystals. Their seeming non-conformity in shape pointed to the possibility of their being new—in angle, or type of form, especially. The results confirmed my first suspicions of their true hexagonal character, though my measurements were only approximate, being made with a hand goniometer.

Since the hexagonal character of the mineral, which seemed so evident, might possibly be due to complex twinning of orthorhombic individuals, it seemed advisable to have this question decided on the basis of an optical examination; and for this purpose three of the best crystals were kindly given by Mr. Hanks, and sent by me to Dr. Edward S. Dana for that exact crystallographic definition needed in this case, and which he always so ably and generously gives to science. The crystals sent being quite clear, Dr. Dana was, in a few days, enabled to report them "as uniaxial (double refraction negative) and that normally," and thus their positive difference from Thenardite was proven beyond question. They were true *hexagonal* crystals. Believing now the mineral to be either a dimorphous form of sodium sulphate, or possibly an entirely new species, an analysis seemed necessary. Accordingly I placed sufficient material in the hands of Mr. James B. Mackintosh, E.M., for that purpose, and he has very kindly done the work. His results showed the mineral to contain the following substances:

SO_3	45.89
CO_2	5.42
Cl.	2.36
*Na_2O	46.34

Corresponding to:

Na_2SO_4	81.45
Na_2CO_3	13.06
NaCl	3.89
Na_2O (excess)	1.08
	99.48

These results give the following molecular ratios for:

Na_2SO_4	57.3	or	3.95
Na_2CO_3	14.5		1.00
NaCl	6.65		.46
Na_2O	1.74		.12

Or closely in the ratio of $4:1:\frac{1}{2}:\frac{1}{8}$. This all points to the formula:

$$4\,(Na_2SO_4) + 1\,(Na_2CO_3) + \tfrac{1}{2}\,(NaCl)$$

As representing the composition of the crystals under examination. Or, neglecting the sodium chloride as non-essential, the formula could be given thus:

$$4\,Na_2SO_4 + Na_2CO_3$$

Which is probably the true one.

The observed excess of soda is either due to errors of analysis, as only a small quantity was used, or it may have been combined with boracic acid, as borax is very abundant at the locality.

The interesting anomaly of a sulphate and carbonate being in chemical combination, reminds us of the rare sulphato-carbonate of lead, Leadhillite, to which this alone bears relation as a natural species.

* All bases calculated as soda. Lime and magnesia were not present.

The angles I obtained were as follows:

O on I = 90°.	O on 1 = 130° 30′
I on I = 120°.	O on 2 = 113° 30′

Accordingly the value of the vertical axis is 1.01399. Cleavage parallel to O nearly perfect, but difficult to obtain.

Crystals striated horizontally. They are commonly terminated at both ends of the prism and are very symmetrical in shape. They average, as thus far seen, about one centimeter in length and thickness, with O and I as predominating planes (see fig. 1).

Fig. 1.

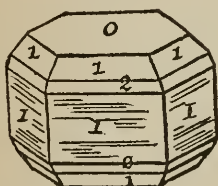
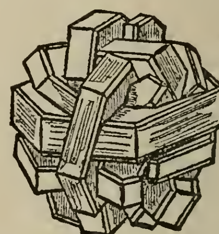


Fig. 2.



Sometimes the crystals are confusedly grouped (see fig. 2), as from a common center, much like the Aragonite from a noted European locality. For some late years mineralogists have received from several localities in the far west, groups of crystals that were hexagonal (tabular) in appearance, very impure in composition, and to which the name of Aragonite has been attached. For the most part they are simply calcium carbonate mixed with sand and mud, and are without cleavage. It is very probable that they are pseudomorphs after the sodium sulphato-carbonate here described. In particular I refer to crystals which I have seen credited to Colorado and to Nevada.

The crystals here analyzed were found with salt, thenardite, tincal, etc., at the works of the San Bernardino Borax Company, in San Bernardino County, California.

The density of this new California mineral is 2.562: its hardness, 3.–3.5: it is readily soluble in water; effervesces with acids. It affords, when dissolved in water, an abundant precipitate of barium sulphate when barium chloride is added to the solution. On addition of silver nitrate, to a fresh solution, chloride of silver is precipitated, showing that chlorine is also present. Gentle ignition developes no appreciable loss in the weight of the mineral.

The crystals are transparent to semi-opaque, with a white, waxy color, inclining to yellow; surfaces never highly polished or very smooth.

The definite formula deduced from Mr. Mackintosh's analysis, taken together with the form, warrants me in announcing these crystals as a new mineral species. I therefore propose for it the name of Hanksite, after Henry G. Hanks, of California.

NEWARK, N. J., May 23, 1885.

[From the American Journal of Science, Vol. XXX, August, 1885.]

Art. XX.—Mineralogical Notes; by Edward S. Dana and Samuel L. Penfield.

1. A Large Crystal of Hanksite.

Some two years since, Professor G. J. Brush placed in our hands for examination, a large crystal, or rather group of crystals, of anhydrous sulphate related to thenardite. The specimen had been received by him from Professor J. S. Newberry, who stated that he had purchased it in California, but was unable to learn the exact locality from which it came. The examination proved it to be probably hexagonal in crystalline form, and in composition to consist of sodium sulphate and carbonate in the ratio of 4 : 1. Feeling reluctant to attach a new name to a mineral of which only one specimen was in hand, and that from an unknown locality, we postponed the publication of our results until some further facts should come to light. The same mineral has now been rediscovered, and in specimens so satisfactory as to justify their receiving the name Hanksite, given by Mr. Hidden.

The specimen examined by us consisted of a low hexagonal prism, measuring transversely 75^{mm}, and in a vertical direction 20^{mm}; this prism is penetrated by several other similar tabular crystals, but in varying positions, so that no general law of twinning can be given. The basal edges were irregularly replaced by pyramidal planes. Apparently the form is hexagonal, the prism and pyramid both being present, and the measured angles of the former showing very little variation from the required 60°. The analogy of the artificial sulphates of sodium and potassium suggested, however, that the form might be really orthorhombic, and the hexagonal aspect due to twinning. The optical examination made to settle the question was not satisfactory, because the crystal contained so much mud as impurity as to be transparent only in spots. Some points were found, however, which gave an obscure uniaxial figure with negative double refraction; but this question might not be regarded as satisfactorily settled were it not for the excellent results which Mr. Hidden's crystals have afforded. The pyramidal plane spoken of was rough and rounded, and was only distinctly seen on part of the edges. The approximate angle (supplement) measured on the basal plane is 43°, which, referred to the vertical axis assumed by Mr. Hidden, gives a symbol $\frac{4}{5}(40\bar{4}5)$; required 43° 8′.

An analysis of the mineral gave (Penfield) the following results, which are almost identical with those of Mr. McIntosh:

		Ratio.				
SO_3	43.59	.545	and	.545	=	43.59 SO_3
Na_2O	40.86	.659		.536		33.23 Na_2O
				.123		7.63 Na_2O
CO_2	5.42	.123		.123		5.42 CO_2
K	2.33	.030				2.33 K
Cl	2.13	.060				2.13 Cl
Insol.	4.41					
Ign.	1.32					
	100.06					

This corresponds then to:

Na_2SO_4	76.82
Na_2CO_3	13.05
KCl	4.46
Insol.	4.41
Ign.	1.32
	100.06

The insoluble portion is apparently clay; a section examined in the microscope showed the impurity densely distributed in bands parallel to the prismatic faces. The fact that in the analysis the potassium and chlorine are present in exactly the amounts required to form potassium chloride may be only a coincidence, and the chlorine may in fact be combined with sodium, and the potassium may in part replace the sodium in the sulphate. It is immaterial which explanation is adopted, but in any case it is quite certain that the potassium (or sodium) chloride is present as an impurity, for in the thin section numerous rectangular crystals, some of them apparently cubes, were visible. It seems proper, therefore, to deduct these elements from the analysis, leaving only the sodium sulphate and sodium carbonate. The result, calculated to 100 per cent, is:

Na_2SO_4	85.48
Na_2CO_3	14.52

This corresponds, though approximately only, to the formula

$$4Na_2SO_4 + Na_2CO_3$$

which requires

Na_2SO_4	84.27
Na_2CO_3	15.73
	100.00

The minerals of California may be classified into two groups—economical minerals, that is those which can be practically used by man—which supply his necessities or contribute to his comfort and convenience—and those which are interesting only for the connection they bear to science. The following is a catalogue of the special California minerals shown at the Exposition. The numbers refer to the museum catalogue:

1430. ACTINOLITE. Contra Costa County.
470. ACTINOLITE. Mariposa estate, Mariposa County.
3443. ACTINOLITE. Twelve miles east of Gilroy, Santa Clara County.
4213. ACTINOLITE. Eureka, Humboldt County.
4335. ACTINOLITE. Santa Rosa, Sonoma County.
4339. ACTINOLITE. Spanish Ranch, Plumas County.
5946. ALKALI (?). Forming a layer in the sandstone deposit, Temple Street Cut, Los Angeles.
4249. ALUM SLATES. Near Auburn, Placer County.
4250. ALUM. Crystallized from No. 4249, near Auburn, Placer County.
4404. ALUM. Near Newhall, Los Angeles County.
4468. ALUM INCRUSTATION. Found ten miles north of Santa Rosa, Sonoma County.
5799. ALUM. This mineral sweats out of bedrock at mouth of tunnel, Bonanza Mine, Gold Run, Placer County.
1795. ANDALUSITE CRYSTALS. Near Ne Plus Ultra Mine, Fresno County.
3700. ANDALUSITE. Moore's Hill, twelve miles south of Mariposa, Mariposa County.
4450. ANDALUSITE CRYSTALS. Imbedded in clay slate (See No. 1795), Fresno County.
2328. ANDRADITE GARNET. Diamond Mountain, Lassen County.
2. ARAGONITE, RED. Suisun, Solano County.
261. ARAGONITE. Suisun, Solano County.
556. ARAGONITE. (Polished.) Suisun, Solano County.
755. ARAGONITE. San Luis Obispo County.

1194. ARAGONITE. Gold Run, Placer County.
1872. ARAGONITE. Soda Springs Hotel, Siskiyou County. Deposited by a spring near the Falls and near the Sacramento River.
2006. ARAGONITE (Onyx Marble). Southeast quarter section nine, township thirty-two south, range fifteen east, Mount Diablo meridian, San Luis Obispo County. Mr. Jacob Z. Davis exhibited a magnificent mantlepiece of this mineral, which attracted much attention. It was set up in the headquarters or reception room, to which it was a great ornament.
2327. ARAGONITE (Onyx Marble). Mineral Spring, six miles above Kernville, Kern County.
2383. ARAGONITE. Twelve miles north of San Luis Obispo.
2740. ARAGONITE CRYSTALS. Candace Copper Mine, Colusa County.
3602. ARAGONITE, white and pure. Johnsonville, Plumas County. This mineral has the property of being easily reduced to a powder, and will no doubt be used as a substitute for chalk in chemical manufacture. Occurs in large quantities nine miles from Jamisons, in Little Long Valley. Four hundred feet wide. Lime has been burned said to be of good quality.
3733. ARAGONITE. Cerro Gordo, Inyo County.
4758. ARAGONITE. Ranch of J. M. Pugh, near Smithville, Colusa County.
5220. ARAGONITE (so called Onyx Marble). From near Yreka, Siskiyou County.
5343. ARAGONITE (slab polished, so called Onyx Marble). Suisun, Solano County. See Nos. 2, 261, 386, 556, 670, all from the same locality, but different varieties.
5345. ARAGONITE (so called Onyx Marble). Found in considerable quantity near Vacaville, Solano County. Takes a high polish, and is suitable for use as an ornamental stone.
1293. ASBESTUS. Shasta County.
1678. ASBESTUS. Eighteen miles northeast of Oroville, Butte County.
2419. ASBESTUS. White River, Tulare County.
2437. ASBESTUS. Lower part of Mount Bullion, one third of a mile east of Bear Valley, Mariposa County. Occurs in a clay formation and is four inches wide (?).
4464. ASBESTUS. Bear Valley, Mariposa County.
1803. AZURITE. New York District, San Bernardino County.
4085. BARITE (Sulphate of Baryta). Found in cleaning up at the Malakoff Hydraulic Mine, North Bloomfield, Nevada County.
4167. BARITE (Sulphate of Baryta). Found as a gangue with silver ore, Calico District, San Bernardino County.
5991. BARITE. Found ten miles above Georgetown, El Dorado County.
2318. BASALT WITH ZEOLITE. Siskiyou County.
4641. BISMUTITE (Stream Bismuth). Found in sluicing for gold, Big Pine Creek, Inyo County.
4237. BRONZITE. Berkeley Hills, Alameda County.
1676. CALCITE WITH BITUMEN. New Almaden Mine, Santa Clara County.
2173. CALCITE. Modoc Mine, Inyo County.
3394. CALCITE WITH PYRITE. Malakoff Mine, North Bloomfield, Nevada County.
3406. CALCITE GEODE. Sweetwater, Nevada County.
3580. CALCITE CRYSTALS. Argus Mountains, Inyo County.
4452. CALCITE (Iceland Spar). Santa Clara County.
5009. CALCITE. Bed of the Klamath River, Yreka, Siskiyou County.
1949. CALCAREOUS TUFA. Mahoney Mine, San Luis Obispo County.
1195. CARBONATE OF MAGNESIA (Magnesite). Gold Run, Placer County.
3025. CARBONATE OF MAGNESIA WITH SILICA. Under the microscrope, cryptocrystalline. Arroyo Seco, Monterey County. Occurs in a vein two feet wide.
4675. CARBONATE OF MAGNESIA. Obtained in the tanks in working the mother liquors in the manufacture of salt by the Union Pacific Salt Company, Alameda County.
1807. CARBONATE OF SODA (Trona). Sink of the Mojave, Death Valley, Inyo County.
1265. CAT'S EYE. Calaveras County.
657. CALCAREOUS SPAR. Point San Pedro, San Mateo County, eighteen miles south of San Francisco.
64. CHALCEDONY. Volcano, Amador County.
546. CHALCEDONY. Murphy's, Calaveras County.
574. CHALCEDONY. Near St. Helena, Napa County.
962. CHALCEDONY. Big Tank, Colorado Desert, San Diego County.
1206. CHALCEDONIC QUARTZ. Vallecito, Calaveras County.
1249. CHALCEDONY. Douglassville, Tuolumne County.
1397. CHALCEDONY. Soledad Cañon, S. P. R. R., San Bernardino County.
4283. CHALCEDONY. Los Angeles County.
4901. CHALCEDONIC QUARTZ. Dry Creek, six miles northeast of Ione City, Amador County.
234. CHALCOCITE, VITREOUS COPPER. San Diego County.
4474. CHALCOPYRITE. Sections 12 and 13, Township 15 north, Range 6 east, Placer County.
4119. CHALCOPYRITE. (Yellow Copper Ore), Beveridge District, Inyo County.
230. CHRYSOCOLLA. San Diego County.
2192. CHRYSOLITE WITH CALCITE. Near Independence, Inyo County.

924. CINNABAR IN SERPENTINE. Tuolumne County.
5952. COLEMANITE. In magnificent crystals. Colemanite is a new variety of Priceite (see No. 157), borate of lime. For description of Colemanite see Third Annual Report of the State Mineralogist, part 2, fol. 86. The specimen is from near Calico, San Bernardino County.
2176. CRYSTALS. Found in furnace slag, Modoc Mine, Inyo County.
3666. CUPROSCHEELITE. (With Tourmaline), Kern County.
1266. DENDRITES. Shasta County.
2122. DENDRITES. Called by the miners "Picture Quartz," Standard Mine, Bodie, Mono County.
2165. DENDRITIC OXIDE OF MANGANESE. Near Volcano, Amador County.
3584. DIALLOGITE CRYSTALS (very fine). Colorado Mine No. 2, Monitor District, Alpine County.
4033. DIAMOND (rough). Spring Valley Hydraulic Mines, Cherokee Flat, Butte County. Weight 180 milligrams. Found in cleaning up sluices, associated with zircons, gold, platinum, iridium, etc. A number of diamonds have been found at this locality, but none of large size or first water.
5063. ENARGITE. Tarshish Mine, Monitor District, Alpine County.
639. ENARGITE with PYRITE. Morning Star Mine, Alpine County.
2805. ERYTHRITE (Cobalt Bloom). Kelsey Mine, Compton, Los Angeles County.
439. FELDSPAR (Orthoclase). Yosemite Valley, Mariposa County.
445. FELDSPAR (Orthoclase) with MOLYBDENITE. Yosemite Valley, Mariposa County.
457. FELDSPAR (Orthoclase). Yosemite Valley, Mariposa County.
4062. FOSSIL RESIN. Hydraulic Mines at North Bloomfield, Nevada County, two hundred and eighty feet below the surface.
687. GALENA (Argentiferous). Searsville, Santa Clara County.
243. GARNETS IN MICA SCHIST. Thirty miles northeast of San José.
2365. GARNETS. Piru Mountains, Ventura County.
96. GOLD IN PYRITES. Drytown, Amador County.
2792. GOLD AND PLATINUM. Concentrated from twenty miners' pans of dirt, Calpella, Mendocino County.
1369. GOLD. From the Bodie mines, Mono County. An alloy of gold and silver, known in mineralogy as Electrum.
4198. GOLD WASHED FROM SANDS (see No. 4197). Upper Gold Bluff, Humboldt County.
4169. GOLD IN MISPICKEL (Arsenical Pyrites). Near Georgetown, El Dorado County.
929. GRAPHITE. Tuolumne County.
1895. GRAPHITE. Guerneville, Sonoma County.
3746. GRAPHITE. Near Pine Flat, Sonoma County.
2190. GROSSULARITE AND DATHOLITE. San Carlos, Inyo County.
354. GYPSUM AND SELENITE. Lockwood Creek, Ventura County, sixty miles south of Bakersfield.
362. GYPSUM. Lockwood Creek, Los Angeles County.
667. GYPSUM. Monterey County.
1721. GYPSUM (Selenite). Near Susanville, Lassen County.
2268. GYPSUM. Near Breckenridge, Kern County.
3726. GYPSUM. Near Hill's Ferry, Stanislaus County.
4647. GYPSUM. Crystallized, near Calico District, San Bernardino County.
5018. GYPSUM. Posa Creek, foothills of the Sierra Nevada, Kern County.
5415. GYPSUM. Of good quality, Bitterwater Ranch, San Benito County.
1721. GYPSUM (Selenite). Near Susanville, Lassen County.
1347. HYALITE ON PYRITES. Kelseyville, Lake County.
1514. HYALITE—A VARIETY OF OPAL. Found plentifully in cavities in basaltic lava, township ten north, and ranges five and six east, Lake County.
1320. HYDROMAGNESITE. Market Street Cut, near Guerrero Street, San Francisco.
3709. ICELAND SPAR, CALCITE. Darwin, Inyo County. This spar is nearly as fine as the true Iceland spar, and could be used for optical purposes.
3731. ILMENITE (in Quartz). Twenty miles south of Mariposa, near Buchanan, Mariposa County.
4044. IRIDIUM FROM CALIFORNIA GOLD. It is found in varying quantities in the crucibles in which the gold is melted.
2262. JAMESONITE. Mokelumne Hill, Calaveras County.
2126. JEFFERISITE. Susanville, Lassen County.
4911. JEFFRIESITE. Tulare County.
813. LENZINITE. Chance Mine, Copper Hill, Shasta County.
2773 LEPIDOLITE. Twenty miles southwest of Colton, San Bernardino County.
4262. LEPIDOLITE, PINK AND WHITE, WITH AZURITE. Vein matter of the Half Dollar Mine, Inyo County; shaft seventy-five feet deep.
5296. LIMONITE CRYSTALS, AFTER PYRITE. Containing gold. Butte County.
130. LITHARGE. San Bernardino County. Probably from ancient furnaces.
423. LITHOMARGE. Alph Mine, Tuolumne County.
1325. LITHOMARGE, WITH FOSSIL LEAVES. Alpha Mine, Table Mountain, Tuolumne County.

2515. LITHOMARGE. Near Big Trees, Calaveras County.
4498. LITHOMARGE. Lassen County.
1175. MAGNESIA (?). Port Harford, San Luis Obispo County.
2322. MAGNESITE (Carbonate of Magnesia). Tulare County.
4238. MAGNETIC SANDS. Mouth of Russian River, Sonoma County.
4139. MAGNETITE CRYSTALS (perfect octahedrons). Shasta County.
1295. MARIPOSITE. Josephine Mine, "Las Mariposas."
159. MICA. El Dorado County.
4064. MICA. Near Lang, Los Angeles County.
4084. MICA. Near Ravenna, Los Angeles County.
3985. MILLERITE (with Cobalt?). Half a mile from Cisco, Placer County.
3748. MOLYBDENITE. Minnie Mine, Sweetwater Range, Mono County.
4102. MOLYBDENITE (Sulphide of Molybdenum). White Mountains, Inyo County.
4126. MOLYBDENITE (Sulphide of Molybdenum). Fresno Flat, Fresno County.
4365. MOLYBDENITE (Sulphide of Molydenum, mistaken for Graphite). Inyo County.
4454. MOLYBDENITE. South Fork of the King's River, Fresno County, fifty-five miles northeast of Visalia.
4336. MOUNTAIN LEATHER (Amphibole). Little Grass Valley Mine, Pine Grove District, Amador County.
4727. MOUNTAIN LEATHER. A variety of Amphibole, found eighteen feet below the surface, near Pine Grove, Amador Gounty. (See No. 4336.)
4970. NITRATE OF SODA. Cave in Calico District, San Bernardino County.
2745. OCHER, IMPURE RED. McPherson's Claim, Sheep Ranch District, Calaveras County.
4010. OCHER, YELLOW. (Limonite), found in considerable quantities adjoining an iron mine (see No. 3765), Campo Seco Township, near Campo Seco, Calaveras County; valuable as a pigment.
4011. OCHER, BURNT. (Same as No. 4010), near Campo Seco, Calaveras County.
5301. OCHER, YELLOW. Of good color and quality; found in large quantity on Section 32, Township 12 north, and Range 11 east, four miles east of Georgetown, El Dorado County.
1251. OPALIZED WOOD. Calaveras County.
4395. OPALS. Stockton Hill, Mokelumne Hill, Calaveras County. When this locality was first discovered, many years ago, the opals were thought to be of great value, and considerable capital and labor were expended to prove them worthless.
4759. PARTZITE. With Native Silver, Galena, etc. Tower Mine, near Benton, Mono County.
2919. PARTZITE. Comanche Mine, Blind Springs, Mono County.
1521. PLATINIRIDIUM. Cinnabar, Mercury, Zircons, etc. Black sand concentration. Hopland, Mendocino County.
1522. PLATINIRIDIUM. Concentrated from No. 1519. Black sand concentration. Hopland, Mendocino County.
1892. PLATINIRIDIUM. Enright Claim, three miles above Trinity Center, Trinity County.
4199. PLATINIRIDIUM. Washed from beach sands (see No. 4197), Upper Gold Bluff, Humboldt County.
4224. PLATINUM, IRIDIUM, ETC. Concentrations from the Spring Valley Hydraulic Mine, Cherokee, Butte County.
512. PICROLITE. Bear Valley, Mariposa County.
555. PICROLITE. Fort Point, San Francisco.
693. PICROLITE. Amador County.
1318. PICROLITE. Market Street Cut, near Guerrero Street, San Francisco.
1439. PICROLITE. Maryland Mine, Grass Valley, Nevada County.
2121. PICROLITE IN SERPENTINE. Yuba River, Nevada County.
4087. PICROLITE. From the Serpentine Rocks, Goleta, Santa Barbara County.
4960. PICROLITE. Near Red Hill, Butte County.
5106. PRICEITE (Borate of Lime). Calico, San Bernardino County.
5646. PRICEITE (variety Pandermite after Ulexite, showing the change from a "cotton ball"). Death Valley, Inyo County. This specimen is referred to in the Third Annual Report of the State Mineralogist, part 2, folio 85.
1671. PSILOMELAIN (in quartz). Santa Ana River, Los Angeles County. Mistaken for tin ore.
351. PYRITES. Morning Star Mine, Alpine County.
3671. PYRITES, GLOBULAR, IN CALCITE. Near Auburn, Placer County.
653. PYRITES. Jackson, Amador County.
981. PYRITES WITH COAL. Spinks Coal Mine, Lincoln, Placer County.
1505. PYRITES (SULPHIDE OF IRON). Redington Mine, Lake County.
1649. PYRITE. Modoc Mine, Inyo County.
1710. PYRITE, RICH IN SILVER, WITH QUARTZ. Iron Mountain Mine, seven miles from Shasta.
2027. PYRITE CRYSTAL. Patterson Mine, Tuttletown, Tuolumne County.
2128. PYRITE. Mono County.
2348. PYRITE. From a cavity in the Sunderland Quicksilver Mine, San Luis Obispo County.

3411. PYRITE, FOUND IN LIGNITE (LARGE TREE). Malakoff Mine, North Bloomfield, Nevada County.
4140. PYRITE, NODULE OF. Found with silver ore, Iron Mountain, Shasta County.
4338. PYRITE, CUBICAL. Knox & Osborn Mine, Calaveras County.
4386. PYRITE (containing also Sulphide of Copper in small quantities, called "white ore"). San Francisco Copper Mine, Spenceville, Nevada County.
4905. PYRITE. Clipper Coal Mine, Lincoln, Placer County.
5428. PYRITE NODULES. Gold Gravel Hydraulic Mine, La Porte, Plumas County.
1811. PYROPHYLLITE. El Dorado County.
3723. PYROPHYLLITE. Greaser Gulch, Mariposa County.
13. QUARTZ GROUP OF CRYSTALS. Wyoming Mine, Panamint, Inyo County.
18. QUARTZ CUT AND POLISHED.
34. QUARTZ CRYSTALS. Placer County.
49. QUARTZ DRUSY. Alpine County.
823. QUARTZ CRYSTALS, GROUP OF. Mariposa Mine, Mariposa County.
828. QUARTZ CRYSTALS. Mariposa Mine, Mariposa County.
1276. QUARTZ PEBBLE. Vallecito Mine, Calaveras County.
1451. QUARTZ CRYSTALS. Calaveras County.
1416. QUARTZ CRYSTALS. Placer County.
138. QUARTZ (HACKED), WITH GOLD. Shasta County.
1449. QUARTZ CRYSTALS COATED WITH MALACHITE. Panamint, Inyo County.
1792. QUARTZ CRYSTALS ON SILVER ORE. From the incline of the Bodie Mine below the four hundred and thirty-three-foot level, Bodie, Mono County.
2164. QUARTZ. (Chalcedony), Volcano, Amador County.
2170. QUARTZ CRYSTAL. Modoc Mine, Inyo County.
2316. QUARTZ, SMOKY. Siskiyou County.
2446. QUARTZ CRYSTAL, SMOKY. North Fork of Feather River, Butte County (?).
2043. QUARTZ, SEMI-OPAL. Referred to as Aragonite in No. 1832. Eighteen miles southeast of Santa Rosa, Sonoma County.
3701. QUARTZ, WITH PYRITE. Both crystallized, El Dorado County.
3710. QUARTZ CRYSTALS (Doubly Terminated). Beveridge District, Inyo County.
3782. QUARTZ CRYSTALS. Standard Mine, Bodie, Mono County.
4143. QUARTZ CRYSTAL (smoky). Beveridge, Inyo County.
4149. QUARTZ (wood opal). Placer County.
4802. QUARTZ (bloodstone). In gravel near Windsor, Sonoma County.
5357. QUARTZ CRYSTALLIZED. Near West Point, Calaveras County.
5163. QUARTZ, TRIANGULAR PRISM (edges modified by planes, see 3782), Standard Mine, Bodie, Mono County.
5538. QUARTZ CRYSTAL. Very large and very fine; one end white, the other smoky. Total length, 13 inches; girth, 15 inches; width of widest face, $2\frac{3}{4}$ inches; weight, 14.5 pounds. Twenty miles north of Placerville, El Dorado County.
5953. QUARTZ TAILINGS. Oregon Ravine, near Placerville, El Dorado County, 1,000 feet below the Pacific Mine.
1827. ROSCOELITE. Granite Hill, El Dorado County. Roscoelite is a vanadium mineral, one of the rarest known, and is always rich in gold.
5768. ROSCOELITE, WITH GOLD. Section 7, Township 11 north, range 10 east, El Dorado County (see Second Annual Report of State Mineralogist, folio 262). Pilot Hill, El Dorado County.
979. SAND, WHITE. Spinks Coal Mine, Lincoln, Placer County. Cook & Spinks. Description of Nos. 979 to 987, inclusive. The formation is nearly as follows: Four feet soil, sixteen feet clay, one foot sand, five feet clay, four feet sand, twenty feet clay; twelve feet alternate layers of coal and clay, varying in thickness from one inch to two feet, eight feet coal—in all. seventy feet.
1145. SAND. From ocean beach, Port Harford, San Luis Obispo County.
1211. SAND, BEACH. Monterey, Monterey County.
1406. SAND, QUARTZ. Spinks' Coal Mine, two miles from Lincoln, Placer County.
1520. (A.) COARSE PORTION (Separated from No. 1519). Black Sand Concentration, Hopland, Mendocino County.
1520. (B.) HEAVY NON-MAGNETIC PORTION BLACK SAND CONCENTRATION. Hopland, Mendocino County.
1520. (C.) MAGNETIC PORTION BLACK SAND CONCENTRATION. Hopland, Mendocino County.
1520. (D.) LIGHT SAND—BLACK SAND CONCENTRATION. Hopland, Mendocino County.
1519. SAND, BLACK. Concentration from hydraulic washing, Hopland, Mendocino County. Mechanical analysis, heavy non-magnetic portion (No. 1520 B), 88.3210 per cent; magnetic portion (No. 1520 C), 8.2420; light sand (No. 1520 D), 2.8740; platiniridium (No. 1522), 0.5505; gold (No. 1523), 0.0125.
1526. SAND CONTAINING GOLD, PLATINUM, ZIRCONS, DIAMONDS (?), AND MAGNETITE. Pine Grove, Amador County.
1588. SAND, COARSE. From the beach at Pescadero, San Mateo.
1673. SAND, MAGNETIC, WITH PYRITES. Hydraulic washings, two miles northeast of Jackson, Amador County.
1675. SAND. From hydraulic washings, two miles northeast of Jackson, Amador County.

2277. SAND CONTAINING GARNETS. Ravine in Soapstone Mountain, twenty-four miles east of Bakersfield, Kern County.
4804. SAND, WHITE. Thirty-two feet from the surface, near Lincoln, Placer County, in its natural state. (See No. 979.)
4286. SAND IMPREGNATED WITH ASPHALTUM, Santa Cruz County.
4864. SAND. Santa Monica, Los Angeles County.
4868. SAND. Seven Palms, 108 miles from Los Angeles.
4865. SAND, RED. Line of the Southern Pacific Railroad, near Rock Creek.
4870. SAND, WITH SHELLS. Colorado Desert, San Diego County.
4881. SAND. Colorado Desert, San Diego County.
4892. SAND CONTAINING ZIRCONS. Hydraulic Mine, Irish Hill, three miles north of Ione, Amador County.
4986. SAND. From a well in the Colorado Desert, San Diego County.
5776. SAND. From beach at Lobitas, San Mateo County.
5781. SAND. Overlying 5780, American River, Sacramento.
5783. SAND, COARSE. Used for building purposes, American River, Twelfth-Street Bridge, Sacramento.
5793. SAND. North Bloomfield Mine, Nevada County.
5795. SAND, COARSE. From bank opposite Marysville, Yuba County.
5796. SAND, FINE. From bank opposite Marysville, Yuba County.
5800. SAND, STRATIFIED. Sixty feet above bedrock, Indiana Hill, Gold Run, Placer County.
5934. SAND, BLACK MAGNETIC. Found between sandstone strata, near Watsonville, Santa Cruz County.
5909. SAND, BLACK MAGNETIC. Alameda.
5910. SAND. From below layer of sandstone, Temple Street Cut, Los Angeles.
5940. SAND, MAGNETIC. French Corral, Nevada County.
5942. SAND. In natural state, sedimentary deposit intercalated with sandstone, Temple Street Cut, Los Angeles.
5945. SAND. Wash of the Los Angeles River, Los Angeles County.
5949. SANDS, HYDRAULIC. Gold Run Mine, Placer County; on bedrock; analysis published in Second Annual Report of State Mineralogist, folio 100, marked No. 1.
5950. SANDS, HYDRAULIC. One hundred and fifty feet above bedrock, Gold Run Mine, Placer County; analysis published in Second Annual Report of State Mineralogist, folio 100, marked No. 2.
5951. SANDS, HYDRAULIC. Three hundred feet above junction of north and middle forks of the American River, Placer County; analysis published in Second Annual Report of State Mineralogist, folio 100, marked No. 3.
5952. SAND. From the American River, 200 feet above junction with Sacramento River, Sacramento County; analysis published in Second Annual Report of State Mineralogist, folio 100, marked No. 4.
4153. SAND INDURATED STRATUM. Four feet above the beach, Pescadero, San Mateo County.
4361. SATIN SPAR (Gypsum). San Bernardino County.
1214. SAPONITE. Santa Barbara.
4055. SCHEELITE. From a quartz ledge on Howard Hill, Grass Valley, Nevada County.
799. SELENITE. Santa Barbara.
957. SELENITE. Near Dos Palmos Station, Southern Pacific Railroad, San Diego County.
1260. SELENITE. Robinson's Ranch, Lake County.
1847. SELENITE (Satin Spar). White River, Tulare County.
2727. SELENITE (Gypsum). Susanville, Lassen County.
2890. SELENITE (Gypsum). Buena Vista, Kern County.
4699. SELENITE. Colorado Desert, five miles west of Volcano Station, Southern Pacific Railroad, San Diego County.
4089. SELENITE. San Emidio Antimony Mine, Kern County.
4465. SELENITE (Gypsum). Bear Valley, Mariposa County. Deposit two feet thick.
4664. SELENITE (Gypsum). Near Modesto, Stanislaus County.
4672. SELENITE (Gypsum). Calico, San Bernardino County.
4765. SELENITE (Gypsum). Near Gilroy, Santa Clara County.
4954. SELENITE (Gypsum). Calico District, San Bernardino County.
5908. SEMI-OPAL. Occurs in a vein four or five feet wide in granite, Tehachipi Summit, Kern County.
1501. SEMI-OPAL. Portersville, Tulare County.
4263. SEPIOLITE. Half Dollar Mine, Inyo County.
449. SERPENTINE. Key's Tunnel, California Mine, Yolo County.
11. SILICIFIED WOOD. Nevada City.
90. SILICIFIED WOOD. Downieville, Sierra County.
304. SILICIFIED WOOD. Columbia, Tuolumne County, sixty feet from surface, between lava and clay.
424. SILICIFIED WOOD. Columbia, Tuolumne County.
486. SILICIFIED WOOD. Eclipse Mine, seven miles west of Lower Lake, Lake County.
1171. SILICIFIED WOOD. Near Angel's Camp, Calaveras County.

1772. SILICIFIED WOOD. Dutch Flat, Placer County.
1855. SILICIFIED WOOD. Near Roseville, Placer County.
1856. SILICIFIED WOOD. Near Calistoga, Napa County.
2167. SILICIFIED WOOD. Near Volcano, Amador County.
2387. SILICIFIED WOOD. Burnell Valley, Sonoma County.
2433. SILICIFIED WOOD AND LIGNITE. Mount Diablo Coal Mines, Contra Costa County.
3423. SILICIFIED WOOD. Omega, Nevada County.
3434. SILICIFIED WOOD. Nevada County.
3444. SILICIFIED WOOD. Chalk Bluffs, Nevada County, South Yuba Mining and Milling Company. A large quantity and great variety of specimens.
3781. SILICIFIED WOOD. Duryea Hydraulic Mine, Chili Gulch, Calaveras County, one mile from Mokelumne Hill.
4113. SILICIFIED WOOD. Twenty feet below the surface, San Luis Obispo County.
4152. SILICIFIED WOOD. Large and remarkably fine specimen. Placer County.
5610. SILICIFIED PALM WOOD (with microscopic section). From North Bloomfield Hydraulic Mine, Nevada County. The silicified woods found in the auriferous gravels of the State are generally conifers, and under the microscope show characteristic dotted ducts. This is the first instance where a palm has been found silicified.
2177. SMITHSONITE WITH CERUSSITE. Modoc Mine, Inyo County.
2918. SILVER NATIVE IN PARTZITE. Comanche Mine, Blind Springs, Mono County.
1632. SPALERITE (ZINC BLENDE). White Chief Mine, Mineral King District, Tulare County.
1633. SPHALERITE (ZINC BLENDE) IN CALCITE. White Chief Mine, Mineral King District, Tulare County.
1891. SPHALERITE (Zinc Blende.) Mineral King, Tulare County.
2154. SPHALERITE (Zinc Blende). Dennis Martin's Ranch, four miles west of Menlo Park, San Mateo County.
4070. SPHALERITE (Zinc Blende), with Calcite. Small Hill Mine, Santa Catalina Island.
1130. STALACTITE. Bass' Cave, Shasta County.
2404. STALACTITES (?). Deposited by jets of steam at the Mud Volcanoes, San Diego County. Qualitative analysis shows Carbonate of Lime, with Silica, Iron, Alumina, Magnesia, and Sulphuric Acid, in small quantities, and considerable common Salt.
3722. STALACTITE. Cave near Volcano, Amador County.
4791. STALACTITES. From Crystal Cave, Cave City, Calaveras County. (See No. 133.)
4792. STALAGMITE. Cave of the Catacombs, near Cave City, Calaveras County, rediscovered July 1, 1881. In this cave there were found great quantities of human bones, of which there is no history, and from which the cave was named.
133. STALAGMITE. Calaveras County.
1129. STALAGMITE. Bass' Cave, Shasta County.
2817. STALAGMITE. Morro, San Luis Obispo County.
3012. STALAGMITE. Cave City, Calaveras County.
4790. STALAGMITE. Found isolated at the foot of a tree, near Crescent City, Del Norte County.
1473. SULPHUR, NATIVE. Sulphur bank, Lake County.
5933. SULPHURETS. Washed from earth taken from a tunnel in the Amador Gravel Mine, near Jackson, Amador County.
438. SYLVANITE—TELLURIC GOLD. Malone's Mine, Stanislaus County.
352. TALC. Seven miles from Mount Hamilton, Santa Clara County.
4247. TALC, FOLIATED, WITH CHALCOPYRITE. San Diego County.
2276. TALC IN QUARTZ. Yosemite Gold Mine, Mariposa County.
3433. TALC, FOLIATED. Altaville, Calaveras County.
2736. THENARDITE. (Anhydrous Sulphate of Soda.) Borax Marsh, Inyo County.
1595. THINOLITE. Largely used for lime. Mono Lake, Mono County.
3697. THINOLITE. Desert, near Volcano Station, Southern Pacific Railroad, San Diego County.
1200. TINCAL. Slate Range, San Bernardino County.
4998. TRAVERTINE. Major's Creek, Santa Cruz County.
2129. TREMOLITE (variety of Amphibole). Santa Cruz Mountains.
1310. TRIPOLITE. Santa Barbara.
1807. TRONA (Carbonate of Soda). Sink of the Mohave, Death Valley, Inyo County.
1108. TSCHERMIGITE. Sulphur Bank Mine, Lake County.
188. TUFA. Santa Cruz, California.
814. TUFA (Ferruginous). Peck Mine, Shasta County.
5427. TUFA (?). Very interesting formation. Gold Gravel Hydraulic Mine, La Porte, Plumas County.
1806. ULEXITE (Borate of Lime). Borax Lake, near Grapevine Cañon, Kern County.
4956. ULEXITE (variety technically called "Sheet Cotton," containing free boracic acid). Death Valley, Inyo County.
3588. VIVIANITE. Brea Ranch, Los Angeles County.
5351. WULFENITE (Molybdate of Lead in small crystals). Found six miles northeast of Cane Springs, Kern County.
4155. ZEOLITE (undetermined, in Lava). North Fork Mining District, Fresno County.
4265. ZEOLITE (in Lava). Eureka, Humboldt County.

A special private collection of minerals, ores, etc., the property of A. Dohrman, of San Francisco, was exhibited by Professor C. D. Voy, also of San Francisco. This really fine and valuable collection was displayed in eight table cases, which were quite crowded. Many of the specimens were from California, and were not only valuable and beautiful, but rare, and in some cases typical. The collection was especially rich in crystallized gold specimens. Most of this fine collection was collected by Professor Voy in years past. He worked under many disadvantages in New Orleans, and deserves great credit for overcoming them, and for the great taste displayed in the arrangement. He promised to prepare a catalogue of the California minerals for this report, but for some reason it was not received in time for publication. Among other exhibits under charge of Professor Voy was a hydraulic nozzle, by Hoskins, of Marysville.

A collection of economic minerals is not of necessity a beautiful one. The ores from which the greater portion of mineral wealth is extracted are generally dull and unattractive to the eye, and are low grade; that is to say, they contain the desirable metal in minute specks or crystals, or mixed with worthless minerals, and disseminated through a large quantity of rock or vein matter; such ores must be crushed, assorted, concentrated, and amalgamated, or smelted, according to their condition, or the nature of the valuable minerals contained in them. A collection of rich specimens only would be a deception, and would mislead those to whom we desire to give information. If all ores extracted from mines were as rich as some exceptional specimens, they would have no more value than granite or sand.

GOLD.

Gold differs from all other metals known to man in having but little intrinsic value beyond what it derives from its scarcity, and from the excessive labor required to obtain it. Why it should be so much desired and valued by the human race is a question that has puzzled philosophers and thinkers from the days of Crœsus to the present time, and no satisfactory solution has been found. Gold is the best known medium in which labor can be stored. Silver, platinum, copper, and a few other metals share this property with gold, but not nearly to the same extent.

Gold is one of the products of a country that cannot, under ordinary circumstances, be over produced. Generally its worth increases with the difficulties of production. It is only when it is discovered in unusual quantities that it decreases temporarily in value. It is to the discovery of gold in unusual quantities in California that we owe the brilliant, almost meteoric flight of our State from a dreamy, slow-going Mexican dependency, to its present advanced condition.

Mankind, when crowded together, become restive, which leads to dissensions and wars; when in that condition the people become unhealthy, and sickness and pestilence follow. By these effects the surplus population is removed, otherwise they could not obtain food enough for their support. When gold is discovered in a new locality, colonists follow the gold seekers, and the pressure is thus relieved. The area of fertile lands on the earth's surface is ample for the support of more than all the inhabitants of the world that have lived upon it at any one time, if the population had been evenly distributed, but there must be some strong incentive to overcome the indolence of an overcrowded community and the natural love of home inherent in man.

Before the golden era of the present century there was an uneasy condition arising from the causes mentioned, the symptoms of which were rather

alarming. The artisan and laborer were poorly paid, and there was no special inducement to cause human progress. The wheels of commerce and manufacture were clogged. There was need of a change, and that change commenced with the discovery of gold in California. Prices went up, as they have always done from the earliest historical period during which gold was largely produced; laborers were better able to support their families in comfort; capitalists, who had for many years accumulated and hoarded gold, were no longer able to dictate prices for wages to the laboring classes. When the California golden discovery was repeated in Australia, an era of prosperity, general intelligence, happiness of the masses, equality, and enterprise commenced which has never been equaled in the history of the world; and should gold from any cause cease to be produced from this time forward, the world would have been greatly bettered and advanced by its discovery and use during the last thirty-four years.

Having shown that the discovery of gold in California was the direct cause of universal prosperity in the United States, I do not hesitate to express the opinion that a sudden and total check to the gold supply would be a national calamity. My reasons for so thinking may be best expressed by an example: Suppose a flour merchant has a large stock of goods, purchased with gold, or its equivalent, when a barrel of flour could only be bought for ten dollars. Assume that the gold mines failing, and the purchasing power of gold for that reason increasing, millers and producers combined would be glad to sell wheat and flour at the rate of five dollars per barrel, in the same gold. The loss to the merchant holding a large stock would certainly be great; yet the intrinsic value of the flour would remain the same. A barrel would make the same number of loaves, and feed the same number of individuals.

Let us show further the influence that gold has on the price of labor as proved by experience in California. If an able-bodied laborer, educated or otherwise, can dig from the ground in a day an ounce of gold, valued at $20, he will not work as a baker at $1 50 per day, which he was willing to do before gold was discovered in California. As a consequence, the price of bread rises. When the conditions are changed, as at present, being no longer independent, the laborer is compelled to accept such wages as the master baker offers. The price of bread not only falls again, but the price of labor also declines, and with it the prices of all the products of labor, and the artisan can only provide his family with the necessities of life, and less of the comforts and luxuries than he was able to furnish them when labor demanded and obtained higher wages. What has been said regarding the rise and fall in the price of bread is true also of all other products of labor.

It is true that when gold is practically retired from trade and commerce, prices will regulate themselves, and the artisan, or common laborer, will be able to do better with the smaller sum he receives as wages; but low wages and low prices are always an index to a correspondingly low state of prosperity. It is my opinion that the present uneasy feeling among the working classes, and fall of prices generally, which is causing so much distress among the merchants and manufacturers, as well as the laborers, is due directly or indirectly to the diminishing production of gold.

This idea is not new or original, for history shows that in every instance a sudden augmentation of the precious metals, and specially of gold, has led to a condition of unusual prosperity, followed by a stage of extravagance, speculation, over production and folly, ending in a fall in prices, stagnation, general distress, and return to the normal condition. We are only repeating history.

The evils of stock gambling we have brought upon ourselves and have none other to blame, but since we have in our wisdom, or otherwise, discouraged the production of gold, we must put up with the consequences. The possession of gold made it possible to live in what seemed to be open violation of the laws of commerce and trade. We could, and did, pay our laboring classes higher wages than could be afforded in other States.

Gold can be produced in California for many years to come, but its extraction is annually becoming more difficult. There are causes in operation which will surely lead to a total suspension of its production in the State, but the supply will not then be exhausted. On the other hand, labor in proportion will become cheaper, and the value, or rather the purchasing power of the gold, will increase. For these reasons mines which years ago would not pay to work, are now being opened and wrought with profit. These remarks apply equally to the gold fields of other States and foreign countries.

Unless some new and productive gold field is discovered, the value of gold will continue to increase, and the reaction already commenced, with its train of evils, will continue until the old condition of low prices, poorly paid labor, and general stagnation returns. There are those who believe that such a change would be an improvement on the present feverish high pressure condition of the world. But the argument of these important questions is foreign to the purpose of this report. In view of the fact that the diminution in the production of gold is the direct cause of the present depression of business and the fall of prices, it would be a wise policy on the part of our people to encourage the production of that metal so abundant in our State, that the inevitable return to the former condition may be as gradual as possible, and not partake of the nature of a crisis. This can be done without the sacrifice of any rights of the agricultural interests, if legislation can be effected in the proper spirit, and the general interest of the whole people be considered.

The two important questions, an increased production of gold, and the impartial distribution of the surplus waters of the rivers of the State for irrigation purposes, should engage the attention of our legislators until an equitable adjustment is effected.

For many years California enjoyed a golden era in more senses than one, during which time our people thought themselves better business men than their neighbors. While the gold lasted they cared but little to compete in manufacturing, because they were to a great extent independent of the rest of the world; but the golden fruit will no longer fall into our hands without the trouble of picking, and while it is a disagreeable fact to admit, we are becoming yearly more and more dependent on the other States and Territories, and can no longer defy the law of supply and demand. If we decide to abandon the gold mines we must encourage agriculture and manufactures. We cannot manufacture successfully unless we can compete with prices of other countries, including that of labor. Otherwise goods can be sold in our market cheaper than we can make them.

We should have a larger and a more industrious population to purchase and use our manufactures. Too many idle men crowd to the cities when they should be in the country working small farms or utilizing the water powers. In adapting ourselves to the new order of things our condition *may* be better in the end, but the transition from our former independence will bring with it a share of bitterness.

It is not fair to open an account with the gold mines of California *per se*. At least, not with the bullion produced, for other and external benefits

have been realized. California gold made it possible to farm on a large scale in a new country. It has planted a great empire on the western slope of the American continent; has made a new market for the world; it has swarmed the bees in the city hives of the East and transferred them to a new and fertile field. The precious metal gathered by them in California and other western States and Territories made it possible for the General Government to resume specie payments at the end of the civil war, and aided materially in carrying that war to a successful ending.

The American citizen may proudly boast that all this metallic wealth has been won by free labor, never before known in the history of the precious metals. One of the most serious mistakes we have made in California, has been the attempt to work all the mines discovered immediately, and to leave nothing for posterity and the future. Were this possible, the resulting over-production would defeat the plan, and the metals extracted would have no value. On the other hand, it can be shown that prospecting, and even the fury of speculation, while often a direct injury to those engaged in it, has been a benefit to the State and to the world. It has made us acquainted with mineral localities that would otherwise have remained for a long time unknown. These localities will furnish, when required, and when they are properly worked, raw material for manufactures and arts. The water-courses have all been studied, and numerous ditches been surveyed. When the placer gold is either practically exhausted, or the mines abandoned, the mining ditches will be repaired and will serve to convey to the agriculturists the water so needful for irrigation.

Suppose we have made some mistakes, cannot we in the future rectify them? Is the experience dearly bought, when the present and coming greatness of our glorious State is considered?

Gold in California is obtained by two distinct and separate methods. One is called *placer mining*, which is simply collecting free gold from natural deposits in which it has been concentrated by forces acting slowly but continuously through many geological ages. The other method is known as *quartz or vein mining*. The material worked is quartz, the natural matrix for gold. It is assumed that the gold in the quartz has been concentrated also by natural causes from the wall rocks or the rock formations in which the veins have been formed. Nature, to produce placer gold, first concentrated that metal in the veins, and subsequently changed the solid rocks, including the quartz, into sediments and finely divided particles. Having practically exhausted the surface placers, man with a vast expenditure of capital and labor attacks the quartz, from which he gathers a small quantity of gold. Tupper had this in mind when he aptly said, "In a mountain of quartz we find a grain of gold."

Placer mining is practiced by various methods, but all of them based on the same general principle—taking advantage of the great specific gravity of gold (19.258) and using water not only to remove the foreign matter, but also to allow the precious metal to settle below worthless material. The first placer mining in the State was simple; it consisted in washing the rich auriferous sediments in a miner's pan, rocker, sluice, or long tom. When the cream was skimmed, and the most accessible placers exhausted, more force and more water were required to collect the disseminated gold. This led to ground-sluicing, in which large and powerful streams were conducted through the claims, while the auriferous earth from the sides was picked down or shoveled into the torrent. The richer sediments gathered by this crude process were further concentrated in sluices and the operation finished in the miner's pan. This mode of mining is

not new. In the old work of Agricola, *De Re Metallica*, published in Latin in the year 1621, on folio 270, a quaint engraving may be found in which ground sluicing is represented, and upon which our modern method is no improvement. The sluices, rockers, pans, and riffles figured in that ancient volume go far to show the truth of the saying, "There is nothing new under the sun."

The next step in advance was "booming." In this operation a large quantity of water was gathered in a reservoir, and at the proper moment a floodgate was opened suddenly and the whole body of water precipitated on the gold field, thus imitating the torrent that nature employed to do similar work, but on a grander scale: this method, too, is old. The process is minutely described in *Pliny's Natural History* (Bohn's edition, vol. 6, fol. 99) and quoted in full in the second annual report of this office, folio 44.

The grand culmination of placer mining is the hydraulic method. "Hydraulic mining," in which water is conveyed for long distances in canals, "*ditches*," to reservoirs, called "pressure boxes," and from them in large iron pipes under great pressure to the auriferous deposits, and projected in powerful streams through nozzles four to nine inches in diameter, against the banks. The operation is assisted by blasts in which hundreds of kegs of powder are employed in a single operation. As far as I can learn this is a modern and a Californian invention. All the details of hydraulic mining, as conducted in California, are described in the second annual report of this office. So powerful is the force used in hydraulic mining that vast quantities of earthy matter are transferred from the banks to the beds of the rivers, causing inconvenience and loss to the agriculturists below, for which reason hydraulic mining has been practically suspended in the State, to the great loss of the community and distress of the miners formerly employed; besides destruction of capital, actual and prospective, which in the end will amount to many millions of dollars. Until some method of placer mining is devised which will admit of the working of the great auriferous beds of the State without injury to other interests, hydraulic mining in California must remain suspended.

Drift mining is another form of placer mining, but in some features resembling vein mining. This is the gathering of gold from the bedrocks on which the auriferous gravel banks lie—generally considered as ancient river channels. The rich deposits are made accessible by tunnels driven into the banks nearly horizontally and parallel to the bedrocks. From these tunnels (drifts) this mode of mining takes its name. There being but little objection made to drift mining, it is likely to be continued as long as it is remunerative. A modified form of hydraulic mining is conducted in Georgia and North Carolina, described under the proper head, but on a small scale indeed when compared with the California operation. All the work done near Dahlonega does not equal in extent one of our smallest hydraulic workings in Nevada County.

Quartz is almost invariably crushed in mills under heavy stamps; here, too, we find that we are but adopting a plan of working in common practice in the time of Agricola. In his work we find figured quartz mills with square stamps almost exactly similar to those first introduced into California. We have made great improvements, but the idea is not new. Even washing the blankets, sluices, riffles, aprons, and other familiar mill appliances, are figured in this remarkable book. It is curious to note the small proportion of gold which can be extracted from quartz with profit in California, which is however rich as compared with that successfully wrought in the Southern States. Quartz which contains $60 worth of gold

to the ton of 2,000 pounds, which is about the highest milled in the State, is in the proportion of one part of gold to 10,049 parts of quartz, while $6 to the ton is equal only to one part of gold to 100,489 parts of quartz.

We are now working gold quartz in California which yields less than the last example, while in Georgia the yield, as shown elsewhere, is still very much less.

The total yield of gold in the State of California has been variously estimated. The actual yield will never be known. The estimate accepted by the State Mining Bureau, including 1884, is $1,078,685,169. The weight of such a mass would be about 3,578,203 pounds, or 1,789 tons, nearly. This enormous quantity of gold, if melted together, would make a cube of about fourteen feet face. A model of such an ideal cube was exhibited in the California department of the Exposition, and small as it seemed, it represented the result of thirty-four years mining, millions of days' labor, and the loss of many lives. On the other hand, the gold represented has been an important and powerful factor in causing the present prosperity and greatness of the American Union. The largest yearly production of gold occurred in 1854, when the yield was about $65,000,000; the smallest was in 1883, when the production had diminished to $13,841,297. The total sum of California gold and silver deposited in the United States Mints to January 30, 1883, was:

Gold	$723,044,046 07
Silver	3,055,850 29
Total	$726,099,896 36

Melville Attwood, F.G.S., of San Francisco, who has been actively engaged in practical gold mining since the year 1835, first in Brazil, and afterwards in California, and one of the first who made a success of quartz milling, in Grass Valley in 1852, has prepared a special paper for this report, given below. It will be of great benefit to the prospectors of California—that useful but unappreciated class to whom we are so much indebted for our knowledge of mineral districts in the State, by them brought to public notice.

MR. ATTWOOD'S PAPER.

A Simple Working Test for Determining the Quantity of Gold mechanically combined with Auriferous Vein-matter.

To Henry G. Hanks, F.G.S., State Mineralogist:

Dear Sir: We have long felt and experienced the want of some practical and correct way of estimating the value of auriferous vein-matter, or gold quartz, which would demonstrate what could be obtained by careful milling—a test that could be applied at the mine, of so simple a character, that those witnessing the trial, though not conversant with mining or milling, would be able to judge of the result, and, if necessary, satisfy themselves of the safety of their money, in case they wished to invest for the futher development, or even the purchase of the mine.

For the greater part of the past fifty years I have been more or less practically engaged in gold mining, and the great importance of some simple and reliable working test has constantly presented itself to my notice, so much so, that I at last determined to try and devise some plan to meet the requirements, and after exhaustive experiments I think that I have, in a great measure, succeeded, and therefore trust I am not out of place in bring-

ing the matter before you and describing as briefly as possible what I recommend, as our science may be said to have grown out of our practice. At the same time I hope that my suggestions, if acted upon, may be the means of preventing in future the erection of costly machinery on worthless mines.

At the present time a renewed interest is beginning to be felt in our California gold mines, so very many of which were abandoned years ago, on which scarcely any work had been done to prove their value, and even such insignificant trials as were made were made at a time when the mining and milling of gold quartz may be said to have been in its infancy; when the proper machinery, water power, and necessary supplies were hardly obtainable, and the use of the improved "hurdy gurdy" wheel unknown. I am of the opinion that in California there is yet, with its unsurpassed climate and facilities for working, a better field for profitable gold mining than in any other part of the world; that is, for medium and low grade quartz.

By "medium grade" I mean rock yielding, say at the rate of from 5 to 12 dollars per ton, and by "low grade" rock yielding from 3 to 5 dollars per ton.

In Tuolumne, Calaveras, Placer, Amador, and Nevada Counties, there are now idle numerous, valuable, and comparatively virgin mines, well worthy of the attention of capitalists, and which offer safe investments to those who will work them, and which are not, like too many of the Mexican mines offered on this market, for the most part worked out or mere holes in the ground. The experienced Mexican miners will not part with their mines so long as they can be made to pay, and as a rule it is only when in a profitless condition that they ask to have them taken off their hands.

In the early days of gold mining in Australia and California, it was thought that the auriferous veinstone would only be found in paying quantities at or near the surface of the ground. One of the most gratifying features of the present time, however, is the fact that rock of a payable nature is now met with in the deep workings of our California gold mines; nearly all our best dividend-paying mines are getting their rock from depths varying between one thousand and fifteen hundred feet; now every increased foot in depth at which payable quartz is found, means the adding of years to the permanency of the gold production of the district.

The discovery of rich rock in depth is of much greater importance than is generally credited. The Idaho mine in Grass Valley is down about 1,500 feet, the Plymouth mine in Amador County 1,400 feet, the Keystone, New York Hill, Empire, Sierra, Buttes, Providence, etc., are all deeper than 1,000 feet.

Through the kindness of W. E. Koch, F.G.S., I am enabled to give you the following particulars of some of the Australian mines:

Name of Mine.	Depth of Reef in feet Producing Gold.	Gold per Ton of 2240 lbs.
Eureka	1200	2 ounces.
New Chum Railway	1100	13 dwts.
New Chum and Victoria	1600	11 dwts.
Lansell's 180 Mine	1760	15 dwts.
Lansell's 180 Mine	2200	14 to 19 dwts.
Londonderry	1200	17 dwts.

I have been told by Australians lately, that Lansell's is down 2,400 feet, and has good pay at that depth.

Many mines in this State have been abandoned when zones of poor quartz have been met with—a fact which is common in lodes. Had the owners sunk a few feet deeper, in all probability they would have come into rich rock again. The unproductive character of that particular portion of the lode may have been caused by a change in the inclosing rock forming its walls. In the Clogan gold mine, Merionethshire, there is a peculiar interstratification of igneous (intruded diabase) and sedimentary rocks, forming the lower silurian deposits of North Wales. In that formation the lodes are only productive when the walls are formed of igneous rocks, little or no gold being met with when the walls are slate, or Cambrean grits.

It is generally conceded by those who have studied the subject, that metalliferous veins owe their productiveness to what the old miners term the "congenial" character of the inclosing, or wall rock, and the Clogan mine proves that even veins yielding the precious metals are not exceptions.

The congenial rocks may be the precipitants of ores from solutions. The ascension theory is that ores found in fissures were only partially derived from the adjoining country rock, and that the greater portion came from a depth, carried into the fissure either by ascending mineral waters, or by sublimation. Some of our best authorities affirm, amongst them Fredolin Sandberger, that the inclosing rocks contain and furnish not only all the constituents of the gangues, but also the ores.

In a work published in 1821, by Westgarth Forster, "A Treatise on a section of the strata from Newcastle upon Tyne to Cross Fell, Cumberland, with remarks on mineral veins," he says of the "Great Limestone;" "This is the most predominate stratum of limestone that we find throughout the whole section, and has been nearly as productive of lead ore *as all the other strata taken together.*"

The same may be said of the "Mountain Limestone" of Derbyshire, and the noncongenial toadstone of that district. At the Ecton mine, in North Staffordshire, all the large bodies of copper ore were found where the walls were of the "great gray limestone," the shale and shaly limestone being uncongenial. At Treasure Hill, White Pine, Nevada, most of the silver ore was found where the walls were of gray limestone, so that in well known mining districts it would be the height of folly to make or continue trails where the walls were of noncongenial rocks; and for new districts, it would be well to draw upon information collected elsewhere. The great falling off in the gold supply of the world during the past few years, restricting, in a measure, the currency of the world, coupled with the very large increase in the supply of the commoner metals, has no doubt, to a certain extent, produced the depression in trade now so generally felt in every part of the globe.

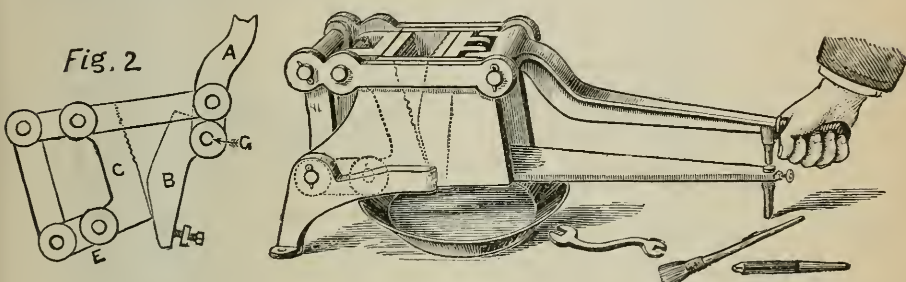
On this coast, the partial exhaustion of the Comstock and Bodie mines, and the stoppage of hydraulic mining, have had a very bad effect; also, of late years, a very much larger appropriation of gold has been required for manufactures and ornamentation.

Sampling the Auriferous Quartz.

The gold quartz from which the working test is to be made, should be taken from the lode at the ends or face of the drifts, backs, or croppings, by an experienced, practical miner, in a quantity of not less than thirteen cubic feet, and should be of as true an average of the rock in sight as can possibly be obtained. The broken thirteen cubic feet should then be con-

veyed to the place selected for making the test, and with spalling hammers broken to the size of macadam stuff, of which, after a thorough mixing, two hundred weight, representing as nearly as possible an average of the whole, should be taken and placed on a piece of canvas about two yards square, in the center of which is a stamp die, and then, with cobbing hammers, the two hundred weight should be reduced small enough to pass through a two-inch riddle; the die is then removed, and the canvas raised from each side, so that the broken quartz be well mixed, from which two samples of four pounds each can then be taken. A "heavy bucking hammer," with a large sized "bucking iron," on a piece of canvas so spread or placed that it will collect what flies or is thrown from under the bucking hammer, will reduce the macadam stuff much more rapidly, and is perhaps better than cobbing. (A bucking hammer is formed of a piece of iron six inches square, and one inch thick, adapted to a wooden handle.) The cobbed four pounds samples should then be passed through Taylor's hand rock crusher till it is fine enough to go through a sieve with thirty holes to the linear inch, or even finer, if considered advisable. The following is the description of Taylor's Crusher:

Fig. 2.



[Hand size.]

The design of this small machine is to enable a person quickly and easily to bring to fine powder the hardest ores, to be assayed, or sampled, or worked. Both jaws are faced with hard white iron, the lower parts of which are plain surfaces, between which the ore is crushed fine. The stationary jaw B has its lower plain surface at an angle to the upper, or corrugated surface. Lower part of this jaw is adjusted by screws, to crush fine or coarse. The movable jaw C is operated by the hand lever A. Jaws, links, and toggles as shown in figure 2. The jaw C has its corrugations horizontal, to facilitate forcing the ore down at each stroke of the lever. This jaw has a vertical and a horizontal motion, the link E forcing plain part of jaw C forward with great force at each downward stroke.

The whole can be quickly taken apart for cleaning, after each lot is worked. To do this, raise the lever A, as in figure 2, and with a tapering drift drive out pin G (upon which lever A turns), then the lever can be thrown over and jaw B removed, and all dusted clean with the brush. To restore parts to position again, replace jaw B, bring back lever and insert pointed drift, and with pin or fulcrum G drive out the drift, and all is ready and clean for next crushing.

The lever has a rubber covering where grasped by the hand, and a rubber cushion where it strikes the bed-piece, to prevent jar and noise. There is a star-shaped piece on top of the lever (not shown), by the turning of which the height to which the lever can be raised is regulated; and when

the lever is raised as in figure 2, this star-shaped piece is turned half around.

Each machine has a cover (not shown) to prevent pieces of ore from flying out, and is furnished with a wrench, drift pin, and dust brush.

Extra jaws and other parts can be had. Weight, complete, eighty-five pounds.

Taylor's hand crusher has many advantages over the common mortar and pestle; first, the rapidity with which it will crush the quartz to the desired fineness, without the stamping and grinding action of the mortar and pestle, by which action so large a proportion of the gold is laminated and floats away when attempts are made to obtain the gold by mechanical assay-washing.

Those conversant with mining and milling, know that there are three modes of reducing gold quartz, copper, silver, lead, and other ores, namely: "crushing," "stamping," and "grinding." The first is effected by horizontal roller rock breakers, the second by stamps, the third by edge mills, pans, arrastras, and millstones.

The great objections to the two latter modes of reduction in the treatment of gold quartz, are the lamination of the gold, and the production, when silver, copper, lead, and other ores are so reduced, of so large a quantity of slimes.

The ore in the condition of slimes, like those from the Comstock mills, is generally in such a state that, so far as I know, all attempts up to this time to profitably recover the metal have failed.

The various simple appliances employed for panning out gold, and the separation of it from pyritic matter and earthy materials, are as follows:

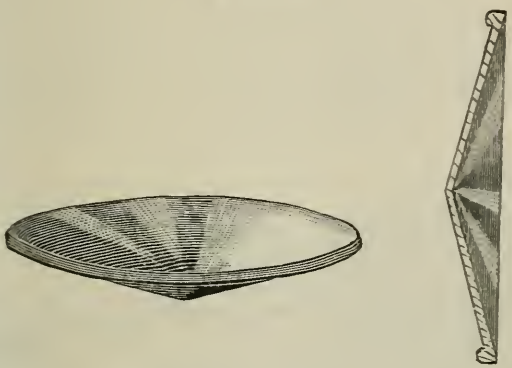
First—The "flat shovel," the use of which is by Cornish ore dressers termed "vanning." The foreman of the different dressing floors where copper, lead, and tin ores are assorted and concentrated for market, necessarily "van" with considerable skill. Vanning is occasionally brought into use in testing for gold. Some of the Cornish and Swansea assayers years ago were perhaps wrongfully accused of "shovel trying," as it was called, instead of making a fire assay of the samples of copper ore sent to them.

Second—The "pan," as used by placer miners and prospectors. It is made out of one piece of sheet iron, and for washing gravel and cleaning up in milling it is vastly superior to any other utensil. A small riddle (piking riddle), similar to those used in assorting lead and other ores, would greatly assist the operation in washing small quantities of gravel. The earthy matter would be more easily removed or cleansed than by rubbing the gravel between the hands. The piking riddle, with about eight holes to the linear inch, has two long handles fixed to it to work it. A large tub partly filled with water is required. The riddle with the gravel in it to be washed is then immersed in the water, and by a sharp quick half-rotary motion the clay or soil is soon removed from the pebbles or gravel. What will not pass through the riddle is then emptied on a table or board so that it can be examined to see if there are any nuggets or cement that require crushing. In estimating the value of "drifting gravel" it is best to do so by the cubic foot, and in the absence of sluices to use the piking riddle and then to wash out the gold with a pan. "In place" the average small gravel will weigh eighteen cubic feet to the ton; on the dump twenty-seven cubic feet.

Third—The "horn spoon," used principally, I believe, by the Mexican miners and millmen to test the mercury in the different stages of the "Patio" and other amalgamation processes. Many of our California

experts use it in prospecting for gold. It is made of various shapes and sizes, but all of them too small to treat a quantity of pulp sufficient for a washing test for gold, besides which the grease from the finger ends in stirring up the pulp in the spoon causes a large proportion of the scale gold to float away on the water, particularly that form of gold generally met with in the cellular portions of the quartz and mostly associated with ferruginous matters. To prove how easily the gold attaches itself to the grease take some sea-beach gold, put into the horn spoon and rub it with the ends of your fingers, then add water to it, and you will find the greater part of it will float away. Nevertheless, with the horn spoon the presence of gold may be detected, but I cannot recommend it for a mechanical or washing assay, the results not being reliable, in fact mere guesswork.

The Batea.



Fourth—The "batea," a wooden bowl or vessel used for washing gold by the Mexican and Brazilian miners, and though these two implements differ very much in size and shape, in skillful hands very good results are obtained from both. My improved form of Brazilian batea, a description of which will be found in your report for 1884, is the result of many years of study. My first attempts were made of zinc, one of which I presented to the Jermyn Street School of Mines, London, in 1851, a cut of which will be found in "Philips' Metallurgy," 1859.

The pattern of my latest improved form I have given to John Taylor & Co., and Mr. Justinian Caire, of this city, who are making them in good form and of suitable wood. The improved batea, if skillfully handled, will give very accurate results, showing nearly every particle of the mechanically combined gold in the veinstone. It is, also, very useful as a concentrator to find the percentage of pyritic matter in the ore.

When the miner is desirous of making a very accurate working test, two bateas should be used, so that the tailings from the first operation can be washed over again. The right hand fingers should also be covered with rubber cots, so that the grease from them may not float the gold: a little washing ammonia should also be added from time to time during the washing or panning out.

In case there is any talcose or greasy matter in the samples of veinstone, it should be soaked in boiling water with a little caustic soda for ten or fifteen minutes before panning out, which can be done in a large glue pot.

When the gold and pyritic matter are brought together in the center of the batea, and well freed from the gangue, allow them to be covered with one

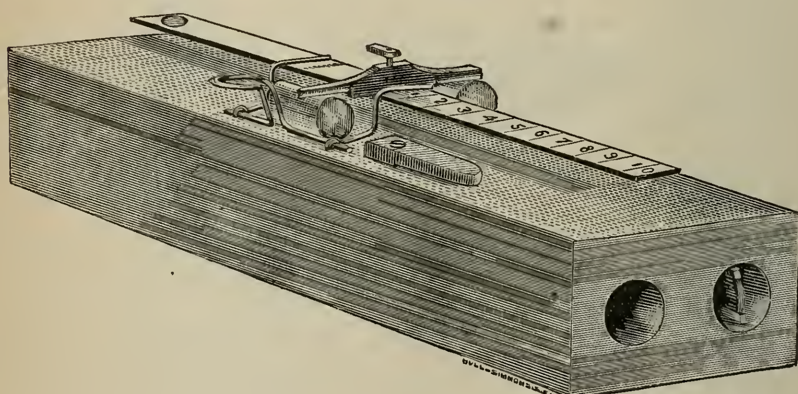
or two inches of water, and then, with a "bar magnet," remove all magnetic iron, which can be easily effected, but care must be taken at the same time, that none of the gold is picked up with the iron; by striking the magnet slightly against the side of the washing tub, the iron will fall from the magnet.

When all the gold is well collected in the center of the batea, a little pure mercury is added sufficient to form a hard amalgam. This mercury being rubbed by the finger covered by a cot, will rapidly take up the gold, the wooden surface of the batea greatly assisting the operation.

The pyritic matter left, if thought to contain any gold, can be ground up fine with water and mercury in an agate mortar, or roasted in a clay dish with a little nitrate of soda, and then amalgamated.

The four-pound samples are then to be treated as directed in using the batea, and the resulting amalgam put in a piece of charcoal, and the mercury volatilized by the aid of a blowpipe, the resulting gold being weighed, the value per ton of rock will be found by the accompany tables. In case the fineness of the gold appears to differ from that of the district, it can easily be determined with sufficient accuracy by the touchstone of testing needles.

The Pocket Balance.



Among the many difficulties I had to encounter in making the working test was first in getting the rock properly and rapidly crushed, and afterward in having the gold washed out of the crushed rock and amalgamated without loss of gold. Messrs. Taylor's hand crusher I found answered very well for the crushing, and the improved form of batea for washing out and amalgamating the gold, but to complete the outfit I required a portable, accurate, and cheap balance. After many attempts, in which I was kindly assisted by M. G. Rockwell and M. Bohn, and taking Dr. Black's invention as a model, I have at last succeeded in making a balance which I think will answer the purpose so well that Messrs. Taylor are now making one something after the same pattern but with improvements.

The balance and frame, as shown by the accompanying drawing, is about seven inches long and one and a half wide and one inch deep. The balance is a German silver beam, six inches long and one fourth of an inch wide; the fulcrum knife-edged and the bearings pieces of round glass.

On the right hand side of the fulcrum ten divisions are marked at equal distances from each other, and on the left hand side a small depression is made to receive the globules of metal or a small pan for gold dust. Above

the fulcrum is a small vane, which being turned to the right or left adjusts the beam to equilibrium. The two small wires resting upon the beam keep it in place while the globules to be weighed are being placed on the beam. By a very slight pressure with the finger the wires are raised and allow the beam to work.

The number of weights required are three, made of flattened wire, viz.: 10 grains, 1 grain, and one tenth of a grain. The weights are moved from one division to another as required to balance the globules, keeping the flat side on the lines of division.

This balance is very sensitive and will weigh to the one thousandth part of a grain.

Holes are made in the wooden block to hold the blowpipe, pincettes, weights, charcoal, etc. The following table is to be used in connection with the balance:

Prospector's and miner's Gold Table, to determine free gold per ton of 2,000 pounds average. Sample for working test, four pounds avoirdupois, 28,000 grains.

Weight of Washed Gold; four-pound sample in grains and tenths.	Fineness, 780: value per oz., $16 12.	Fineness, 830: value per oz., $17 15.	Fineness, 875: value per oz., $18 08.	Fineness, 920; value per oz., $19 01.
5 grains	$83 97	$89 36	$94 20	$99 05
4 grains	67 18	71 49	75 36	79 24
3 grains	50 38	53 61	56 52	59 43
2 grains	33 59	35 74	37 68	39 62
1 grain	16 79	17 87	18 84	19 81
.9 grains	15 11	16 08	16 95	17 82
.8 grains	13 43	14 29	15 07	15 84
.7 grains	11 75	12 51	13 19	13 86
.6 grains	10 07	10 73	11 30	11 88
.5 grains	8 40	8 93	9 42	9 90
.4 grains	6 71	7 14	7 53	7 92
.3 grains	5 03	5 36	5 65	5 94
.2 grains	3 36	3 57	3 76	3 96
.1 grains	1 68	1 78	1 88	1 98

Table

For determining the amount of free gold per ton of 2,000 pounds average. Sample for washing, 29,166⅔ grains, approximately 4 pounds 2¾ ounces.

Each grain of gold obtained after washing will, therefore, equal 1 ounce per ton. If the gold be—

750 fine, each ounce will be worth	$15 50
800 fine, each ounce will be worth	16 53
850 fine, each ounce will be worth	17 57
875 fine, each ounce will be worth	18 08
900 fine, each ounce will be worth	18 60
920 fine, each ounce will be worth	19 01
930 fine, each ounce will be worth	19 22
940 fine, each ounce will be worth	19 43
950 fine, each ounce will be worth	19 63

Hence, multiply the value per ounce by the number of grains to give the value per ton. Example: If the washed gold weighs 2 grains, and the fineness be known or estimated at say $16 53 per ounce, the sample shows $16 53 × 2 = $33 06 per ton.

I lately had occasion to make a cursory examination of what at one time was considered a very important mining district—Meadow Lake. A large town was built, then called "Summit City," which "city" might be said to have been built up by high assays, and let down by working results.

It had a reported population of about 5,000, brick hotel, stock board, etc. I am also told that 100 different mining locations were recorded, and seven quartz mills erected. Now the place is quite deserted, and the mills and buildings, with few exceptions, in ruins.

It is impossible to say how many indescribable processes were tried there to save the gold, from numerous high assays they were led to believe the veinstone contained. The samples which gave high assays were supposed to have been taken by parties who thoroughly understood the business. The assay certificates of Meadow Lake rock, if bound up together, would make quite a large volume.

Vast sums of money must have been expended—how much, it is impossible to tell; but I feel assured that had the simple practical test which I have now tried to describe to you been applied at the mines by some experienced hand, the greater part of the money would have been saved; and from the cursory examination I made of the district, I feel satisfied many of the large mines would now be in successful operation. The auriferous veins in Meadow Lake are of low grade, containing considerable pyritic matter and zinc blende; the blende and a large proportion of pyritic matter, however, does not carry gold.

At the croppings a considerable portion of the pyritic matter has undergone decomposition, leaving in the cellular quartz films and scales of gold. Samples taken from such parts might account for some of the high assays.

The wholesale failure in the mining and milling at Meadow Lake was a lesson dearly bought, but at the same time the best evidence I can advance to show the great value of reliable practical working tests, and also the desirability and necessity, when an examination of a gold quartz mine is required, to employ a thoroughly practical man, who has had years of practical experience in the working of that class of mines, and who also understands the way of taking samples to correctly represent the rock in sight.

I trust the day has gone by when breaking small pieces of rock from here and there in the lode for fire assay, or, worse still, pounding in a mortar and afterwards attempting to wash out the gold with greasy fingers in a horn spoon, and then by the aid of a powerful magnifier guessing the gold contents of the rock, will be considered a reliable assay.

Low grade ore, that carries a large proportion of pyritic matter with zinc blende, like the Meadow Lake ores, cannot be milled without considerable loss, and the lower the grade the greater the loss. With such ore, battery amalgamation is out of the question, so that the treatment to be adopted must be the same as that in use at the St. John del Rey mine, in Brazil, namely, concentrations, though, from the published accounts of that company, their mode of concentration is very imperfect, and the *cold* amalgamation, depending on the atmosphere for temperature, sadly behind the age.

At a meeting of the St. John del Rey company, June eighteenth, the proceedings of which were published in the *Mining World and Engineering Record*, the Chairman, Mr. Hocking, gave some interesting particulars regarding the great loss in milling their low grade sulphuretted ore. It appears that when the gold contents by assay were at the rate of $9 33 per ton they only recovered $7, losing $2 33, or about 33 per cent. From their Cinabo mine, a much lower grade of ore, they only recovered $3 from $6 ore, a loss of 50 per cent.

In one of their old reports for 1866 it is stated that during the year they milled 60,685 tons of ore, the average gold contents of which by assay was $23, from which they recovered $19 50, losing $3 50, or about 15 per cent.

Comparative Statement of Assays and Results.

Months. 1866.	Mineral Treated.	Contents Per Assay.		Produce in Reduction.		Loss on Process.		
	Tons.	Per Ton Oitavas.	Total Oitavas.	Total Oitavas.	Per Ton Oitavas.	Total Oitavas.	Per Ton Oitavas.	Per Cent.
January	5072.8	9.889	50.169	44.487	8.768	5.682	1.121	11.32
February	4663.2	11.388	52.872	44.199	9.478	8.673	1.860	16.40
March	5144.8	11.486	64.243	55.074	10.703	9.169	1.783	14.27
April	5019.2	11.506	57.752	47.416	9.446	10.336	2.060	17.87
May	5373.6	11.520	61.898	57.541	10.707	4.357	0.813	7.03
June	5271.2	10.911	57.517	49.494	9.388	8.023	1.523	13.94
July	5195.2	10.473	54.411	45.737	8.803	8.674	1.670	15.94
August	5033.6	11.673	58.758	49.378	9.809	9.380	1.864	15.96
September	4442.4	11.809	52.461	45.371	10.213	7.090	1.596	13.70
October	4980.2	12.516	62.304	50.973	10.235	11.331	2.275	18.18
November	5170.6	12.437	64.311	54.425	10.524	9.886	1.913	15.37
December	5318.3	11.525	61.296	99.693	9.343	11.603	2.182	18.92
Totals	60685.1	11.501	697.992	593.788	9.780	104.204	1.720	14.92

These mines were purchased by an English company more than half a century ago, and have paid dividends for the greater part of that time. The company have always employed men of great talent to manage the reduction works.

Careful analyses have been made of sulphurets or concentrations of our California mines and those of Brazil; the difference, if any, is very trifling, so that the gold in the raw sulphurets of our California mines may be amalgamated in barrels, the same as in Brazil, provided the operation be properly conducted and pyritic matter reduced fine enough, and free from decomposition.

A very cursory examination of the lead mines in the lower carboniferous rocks of the Alston Moor District (north of England) would in a short time convince any one of the truth of what are called "congenial rocks."

The following is a catalogue of California gold mines represented in the Exposition. For description and names of donors see corresponding numbers in museum catalogue:

5070. Akin or Virginia Mine, near Coulterville, Mariposa County.
2372. Alabama Mine, near Jamestown, Tuolumne County.
1865. Alabama Mine, near Penryn, Placer County.
111. Alaska Mine, Sierra County.
3744. Albion Mine, Meadow Lake, Nevada County, complex ore. This specimen will be carefully analyzed and the results published.
456. Al. Bunnell Mine, Kern County, Slickensides.
462. America Mine, North San Juan, Nevada County.
4362. Baltimore Mine, near Kelsey's, El Dorado County.
465. Bald Mountain, Forest City, Sierra County, cement with gold.
1794. Banghart Mine, Shasta County, sulphurets.
3445. Banghart Mine, ten miles north of Shasta, Shasta County, gold in porphyry.
2346. Banner District, San Diego County.
2812. Basco Mine, San Antonio Creek, Calaveras County.
1908. Basin Slope Mine, Tuolumne County.
4120. Beveridge District, Inyo County, gold in cellular quartz.
3719. Beveridge District, Mono County, gold on quartz crystal. The gold has the appearance of having been formed in the crystal, but close inspection shows that it is cemented on the outside by oxide of iron.
293. Big Blue Lead, Kern County.
909. Black Mine, Tuolumne County.
2429. Blue Lead, Sierra County, gold in cement.
380. Blue Ledge Mine, Kelsey Flat, El Dorado County.
1268. Bodie Mine, Mono County.

4744. Bodie Mine, Mono County, quartz with gold (electrum).
1541. Bodie Mine, Bodie Mining District, Mono County, gold and silver.
3778. Bodie Mine, east drift, Bodie District, Mono County.
677. Boston Mine, Latrobe, El Dorado County.
120. Boynton Mine, near Soledad, Monterey County.
2870. Bright Star Mine, Piute Mountain, Kern County.
1457. Brunswick Gold and Silver Mining Company, Nevada County.
1278. Calaveras Mine, Calaveras County.
344. California Con. Mine, Gold Tunnel, Nevada County.
4156. Carga Muchacho Mine, twelve miles west of Fort Yuma, San Diego County. Up to June 17, 1882, this mine has produced 14,000 tons of quartz, which yielded in the mill at El Rio, $167,000. This statement is made by Mr. Wm. Sublette, by whom the specimen is donated.
100. Cedarburg Mine North, El Dorado County.
1456. Central Mine, three miles north of Haywards, Amador County.
279. Cerro Gordo Mine, Inyo County.
3424. Champion Mine, Yuba River, near Omega, Nevada County.
897. Chaparral Mine, Tuolumne County, gold quartz in slate, sixty feet deep, two feet wide.
2351. Cherokee Mine, Tuolumne County.
2103. Coe Mine, Coulterville, Mariposa County.
388. Confidence Mine, Fresno County.
2823. Conrad Mine, Duncan Hill, one and a half miles west of Auburn, Placer County, one hundred and fifty-foot level.
1881. Corbet's Creek Mine, Mariposa County, gold-bearing sulphurets in quartz.
5314. County Line Mine, Bishop Creek District, Inyo County.
650. Crescent Mine, Plumas County.
1285. Crown Point Mine, Amador County.
——. Crystal Mine, El Dorado County.
2374. Crystalline Mine, near Jamestown, Tuolumne County.
3029. Dahlonega Mine, section twelve, township sixteen north, range eleven east, Placer County.
2885. Deadwood Mine, Nevada City, Nevada County.
2452. Delano Gold and Silver Mine, Deer Creek, Tulare County.
4491. Diadem Quartz Mine, Edman District, Plumas County, gold in quartz, cut and polished specimen.
1878. Doss Mine, two miles from Hornitos, Mariposa County, gold-bearing sulphurets.
5047. Dover Mine, Humbug Cañon, Placer County.
4166. Dudley Mine, Meadow Lake District, Nevada County.
566. Dutch Boy's Mine, near Railroad Flat, Calaveras County.
1502. El Capitan Mine, North Fork District, Fresno County.
2321. El Carmen Mine, Hite's Cove, Mariposa County.
2032. El Dorado County, auriferous pyrites, contains 21.4 ounces of gold to the ton.
2138. Euchre Bar Mine, section five, township fifteen north, range eleven east, Placer County, contact vein.
4375. Excelsior Mine, Meadow Lake District, Nevada County, auriferous pyrites.
3745. Excelsior Mine, Meadow Lake District, Nevada County, complex ore.
974. Fall Creek Mine, near Emigrant Gap, Nevada County, gold quartz with free gold.
1629. Fall Creek Mine, Washington Township, Nevada County, quartz with telluric gold.
572. Farrall Mine, James Bar, Mokelumne River, Calaveras County.
2912. Flag Mine, Brown's Valley, Yuba County.
1398. Fresno Enterprise Mine, five miles from Fresno Flat, Fresno County.
4922. Gagnere Mine, section thirty-two, township two north, range fourteen east, in the town of Tuttletown, Tuolumne County.
1093. German Mine, near Placerville, El Dorado County.
320. Glencoe Mine, Calaveras County.
5061. Godfrey Gravel Mine, Grass Valley, Nevada County, cement with gold.
2769. Gold Blossom Mine, one thousand feet south of St. Patrick Lode, Placer County.
3676. Golden Crown Mine, Coulterville Mining District, Mariposa County, vein matter. This specimen is remarkable, as showing the effect of solfataric action in the vein.
249. Golden Gate Mine, two miles from Sonora, Tuolumne County, gold quartz with mass of sulphurets.
898. Golden Gate Mine, Tuolumne County, gold quartz in slate, one hundred feet deep.
3429. Golden Hero Mine, near Copperopolis, Calaveras County.
2796. Gold King Mine, three miles southeast of Cherokee Flat, Butte County.
5031. Gold Mountain Mine, near Jamestown, Tuolumne County.
5032. Gold Mountain Mine, 400-foot level, near Jamestown, Tuolumne County.
5033. Gold Mountain Mine, 600-foot level, near Jamestown, Tuolumne County.
5034. Gold Mountain Mine, 850-foot level, near Jamestown, Tuolumne County.
5035. Gold Mountain Mine, near Jamestown, Tuolumne County, wall rock (foot wall).
5036. Gold Mountain Mine, near Jamestown, Tuolumne County, wall rock (hanging wall).
4853. Gold Quartz Mining Company, Nevada City, Nevada County.
2091. Gold Run Mine, from the hanging wall, sixty feet from surface. Tunnel cuts the

vein at sixty feet, shaft forty feet, vein sixteen feet wide, section thirty, township ten, range nine, Webber Creek, El Dorado County.

2900. Gold Run Mine, Webber Creek, El Dorado County, croppings.
466. Golden Star Mine, Alleghany, Sierra County, cement with gold.
257. Gold Virgin Mine, Mariposa County.
16. Good Friday Mine, Placer County, gold quartz.
379. Good Hope Mine, Piru District, Ventura County.
2908. Grasshopper Mining Company, Mosquito Gulch, Calaveras County.
3392. Green Valley claim, near Dutch Flat, Placer County, chimney rock.
903. Grizzly Mine, Tuolumne County, one hundred and fifty feet deep.
1094. Gwinn Mine, Calaveras County.
571. Hackendorn Mine, Blue Mountain, Calaveras County.
1597. Hanover Mine, average ore, Fine Gold Gulch, Fresno County.
1598. Hanover Mine, Fine Gold Gulch, Fresno County. This specimen shows electrum in wire form.
2516. Hayden Hill Mine, Lassen County.
919. Heslep Mine, Tuolumne County. One hundred and fifty feet deep.
5037. Hidden Treasure Mine, near Murphy's, Calaveras County.
474. Hite Mine, Mariposa County.
3715. Hite Mine (900 foot level), Hite's Cove, Mariposa County.
1393. Homer Mill and Mining Company, Mono County.
3630. Hoosier Bar, Middle Fork of American River, eight miles from Auburn, Placer County, placer gold.
375. Humming Bird Mine, Piru District, Ventura County.
2754. Hungry Gulch, near Pine Cove, Amador County, gold crystal.
5060. Idaho Mine, Grass Valley, Nevada County, ordinary ore, and rich ore from 1,400-foot level.
2824. Indian Valley Mine, Indian Valley, Placer County.
917. Jackson Tunnel, Mariposa County, gold quartz in granite.
3008. Jenny Lind, Calaveras County, half ounce of placer gold.
4287. Jones' Mine, old Carson Creek Gold and Silver Mining Company, Carson Creek, Calaveras County, ores containing tellurium.
477. Josephine Mine, Bear Valley, Mariposa County, croppings.
5071. Jumper Mine, Hayden Hill, Lassen County.
2054. Kanaka Mine, six miles from Downieville, Sierra County.
239. Kentuck Mine, Long Tom District, Kern County.
3596. Keynote Mine, Beveridge District, Inyo County. This specimen is peppered with fine gold, which can only be seen by close inspection.
272. Keystone Mine, Amador County.
628. Keystone Mine, east vein, Amador County, five hundred and fifty-seven foot level.
629. Keystone Mine, Amador County, west side of vein.
630. Keystone Mine, Amador County, five hundred and fifty-seven foot level, Spring Hill vein, one hundred and fifty feet south of Patton.
631. Keystone Mine, Amador County, five hundred and fifty-seven foot level, south shaft.
1843. Klamath Mine, Siskiyou County.
2826. Knox & Osborn Mine, Calaveras County, sulphuret ore. There is a twenty-stamp mill on the property, with concentration apparatus.
926. Lookout Mine, Tuolumne County.
2734. Little Gem Mine, near Jamestown, Tuolumne County.
916. Louisiana Mine, Tuolumne County.
2871. Macedonian Mine, Kern County.
4278. McKinnon's Flat, Calaveras County, cement, containing gold.
1564. McNulty Mine, Electric Mining Company, El Dorado County, California.
2774. Mad Ox Mine, near Whisky Creek, Shasta County.
5068. Madre Mine, Carga Muchacho District, San Diego County.
3403. Malakoff Mine, North Bloomfield, Nevada County, hard cement, with gold.
925. Mammoth Mine, seven feet thick, Tuolumne County.
2868. Manzanita Mine, Sulphur Creek, Colusa County, gold deposited on the surface of quartz crystals, a most remarkable and interesting specimen.
4754. Manzanita Gold Mine, Sulphur Creek, Colusa County, croppings.
3368. Manzanita Mine, Sulphur Creek, Colusa County, sulphur, cinnabar, and gold, large specimen.
478. Mariposa Tunnel, Mariposa County, two thousand five hundred foot point.
4364. Mark Twain Mine, Angel's Camp, Calaveras County, croppings, very rich in gold.
4357. U. S. Grant Mine, Meadow Lake District, Nevada County.
438. Melones Mine, Stanislaus County, telluric gold—sylvanite.
2421. Mexican Mine, one hundred feet deep on shaft, Mariposa Estate, Mariposa County.
2010. Miller Mine, Washington, Nevada County.
3577. Modesto Mine, Beveridge Mining District, Inyo County, ferruginous quartz with gold in a cavity formerly occupied by a large crystal of pyrite.
3727. Modesto Mine, four miles above Mormon Bar, Mariposa County, sulphuret ore.
3576. Mohmann Mine, Big Oak Flat, Tuolumne County.
1546. Mono Mine, Bodie District, Mono County. Four-hundred-foot level. Sixty feet already passed through.

5052. Monticello Mine, Sulphur Creek, Colusa County.
1833. Mt. Auburn Mine, same vein as the Providence Mine, one hundred and seventy-five foot drift, vein six feet wide, near Nevada City, Nevada County.
2803. Mount Auburn Mine, Providence Ledge, three miles north of Nevada City, Nevada County.
2883. Mountain Mine, Nevada City, Nevada County, sulphuret ore.
675. Morning Star Mine, Siskiyou County.
674. Murchie Mine, five-hundred-foot level, Nevada County, telluric gold ore.
2427. Murchie Mine, Nevada County, two miles from Nevada City, sulphuret ore.
3421. Murchie Mine, Nevada County, gold quartz.
144. Nevada Mine, Nevada County.
4043. Nevada Hydraulic Mine, Chalk Bluff, Nevada County, placer gold.
5213. Nevada Hydraulic Mine, Chalk Bluff, Nevada County, mechanical and semi-chemical analysis of auriferous gravel. (See Second Report of State Mineralogist, 1882, folio 97.)

	Per Cent.	Per Cent Quartz.
Portion "A," zircon sand	00.01	----------
Portion "B," large pebbles	39.80	89
Portion "C," coarse gravel	29.80	63
Portion "D," remained on No. 10 sieve	7.67	57
Portion "E," remained on No. 20 sieve	1.03	59
Portion "F," remained on No. 40 sieve	3.13	78
Portion "G," remained on No. 60 sieve	3.90	86
Portion "H," remained on No. 80 sieve	1.53	80
Portion "K," remained on No. 100 sieve	1.37	82
Portion "L," passed No. 100 sieve	1.47	72
Portion "M," slickens	10.29	Nearly all

5289. Nevada City Mine, one and a half miles from Nevada City, Nevada County, sulphuret ore, with visible free gold.
1204. New Albany Mine, Tuolumne County.
2897. New England Mine, Nevada County, sulphuret ore.
2025. New Toledo Mine, section thirty-one, township two north, range fourteen east, Tuolumne County.
——. Niagara Mine, Shasta County.
5069. Nice and West Mine, Nevada County, cement with gold.
1422. Nioma and Wasatch Mines of the Homer Mill and Mining Company, Homer District, Mono County.
5066. Oakland Mine, Grass Valley, Nevada County. Oakland Gold Mining Company.
1515. Occidental Mine, Nevada County, pyrite and hermatite (rich in gold).
2454. Olsen Mine, Tuolumne County, near La Grange.
1506. Oro Mine, Bodie District, Mono County, medium grade.
2450. Oro Fino Mine, El Dorado County. Thirty foot level said to be rich in gold. This rock is principally quartz, with some calcite and a large quantity of bright crystals of pyrites, very interesting when seen under the microscope.
2821. Owens' River Mine, Goldopolis District, Inyo County, gold and silver ore.
5067. Padre Mine, Carga Muchacho District, San Diego County.
4600. Palma Mine, Cerro Gordo, Inyo County, gold in calcite.
905. Patterson Mine, Tuolumne County, gold quartz in slate. One hundred feet deep.
7. Peter Walter Mine, Placer County.
4197. Pioneer Mining Company, Upper Gold Bluff, Humboldt County, auriferous sands.
3720. Pioneer Union Mine, Humbug District, Placer County. Three hundred feet below the croppings, ledge four and a half feet thick.
390. Pitman Mine, Fresno County.
2329. Pinacate District, twenty-four miles south of Colton, San Bernardino County, rock very rich in gold.
5072. Poule Mine, Clipper Gap, Placer County.
644. Premium Mine, Plumas County.
514. Princeton Mine, Mariposa County.
2026. Prospect Mine, section thirty-one, township two north, range fourteen east, near Rawhide Ranch, Tuolumne County.
648. Providence Mine, Nevada County, gold with pyrites.
709. Quartz Glen, six miles from Mokelumne Hill, Calaveras County.
2172. Royal Arch Mine, six miles south of Modoc Mine, Inyo County.
5312. Sacramento Mine, near Bishop Creek, Inyo County.
638. St. Lawrence Mine, Placer County, near Ophir.
229. St. Patrick Mine, Placer County, gold quartz and iron pyrites.
76. St. Patrick Mine, Placer County, gold quartz.
1960. Shady Glen, near Alta, Placer County, concentrations from hydraulic mines.
347. Shanghai Mine, near Columbia, Tuolumne County.

906. Shaw Mine, Tuolumne County.
3705. Sheep Ranch Mine, Calaveras County, gold quartz, showing free gold.
——. Sierra Buttes Mine, average ore from 8th level, 1,350 feet from surface.
912. Soulsby Mine, Tuolumne County, gold-bearing sulphurets.
913. Soulsby Mine, Tuolumne County, gold quartz in granite, 550 feet deep, one foot thick.
922. Soulsby Mine, Tuolumne County, concentrated tailings.
3703. Soulsby Mine, Tuolumne County, gold quartz.
5329. Soulsby Mine, section thirty-one, township two north, range sixteen east, Tuolumne County, galena, with heavy gold.
5330. Soulsby Mine, Tuolumne County, galena, with quartz and free gold, from above the second level.
5331. Soulsby Mine, Tuolumne County, white quartz, with galena, very rich in gold above the second level.
5332. Soulsby Mine, Tuolumne County, quartz, with gold sulphurets, from the fifth level.
5333. Soulsby Mine, Tuolumne County, quartz, from winze below the bottom level. The deepest workings in the mine, 640 feet.
5334. Soulsby Mine, Tuolumne County, quartz, largely impregnated with gold, very rich, from the stope below the deepest level.
5335. Soulsby Mine, Tuolumne County, quartz, with sulphurets, from above the bottom level, north workings.
5336. Soulsby Mine, Tuolumne County, quartz, with iron pyrite; heavy gold in the quartz, and also in the pyrite; from the No. 6 level.
5337. Platt Mine, extension of the Soulsby Mine, Tuolumne County, quartz, with galena and gold.
5338. Soulsby Mine, Tuolumne County, heavy gold, in close association with granite.
5339. Soulsby Mine, Tuolumne County, quartz, with gold and pyrite.
1252. Spring Valley Hydraulic Mine, Grass Valley, Nevada County, auriferous gravel.
4225. Spring Valley Hydraulic Mine, Cherokee, Butte County, placer gold in cement.
5210. Spring Valley Hydraulic Mine, Cherokee, Butte County, blue gravel, bottom stratum, lying on bedrock, from six to ten feet deep.
5211. Spring Valley Hydraulic Mine, Cherokee, Butte County, white top gravel, from twenty to four hundred feet thick, overlying rotten bowlders (No. 5212).
5212. Spring Valley Hydraulic Mine, Cherokee, Butte County, yellow, or rotten bowlders, stratum from one to ten feet thick, overlying blue gravel, No. 5210, and covered by No. 5211. This deposit is rich in gold.
660. Standard Mine, Bodie District, Mono County.
4453. Star Mine, near Mud Springs, El Dorado County, auriferous quartz, with calcite, also auriferous. Some small specimens brought to the Mining Bureau from the same locality were wholly calcite, in which free gold was imbedded, which led to the impression that the whole fissure was filled with that mineral. This specimen shows this to be a mistake. The occurrence of calcite in mineral veins is not uncommon. The gold in this mine is light colored, from being alloyed with silver—electrum. This and the presence of calcite shows a mineral vein unlike the common quartz ledges of the State, indicating silver and other minerals at a greater depth.
1455. Star Mine, Tuolumne County.
4216. Star of the West Mine, West Point, Calaveras County, pyritic ore (auriferous).
——. Stockton Mine, near Madeira, Fresno County.
2369. Succedo Shaft, fifty feet below Mariposa Tunnel, Mariposa Estate, Mariposa County, gold-bearing quartz.
2422. Succedo Shaft, five hundred feet below the surface, Mariposa Tunnel, mother vein, Mariposa Estate, Mariposa County, quartz.
2853. Sugarman Vein, Sonora, Tuolumne County, crystallized gold.
1695. Summit City, Sierra County, sulphuret ore.
899. Sweeny Mine, Tuolumne County, gold quartz in slate, one hundred feet deep.
8777. Syndicate Mine, Bodie, Mono County.
171. Talisman Mine, Amador County.
1527. Tellurium Mine, Pine Grove, Amador County.
5433. Thomas and Reed's Mine, Poor Man's Creek, Plumas County, concentrations.
2916. True Fissure Mine, Devil's Peak Mountain, Placer County, auriferous pyrites.
2373. Tulloch Mine, near the Summit, Tuolumne County, five miles south of Sonora and Mono road.
480. Gold quartz, Union Mine, Carson Hill, Calaveras County.
139. Ore, from Venando Gold Mine, Napa County, five miles from St. Helena.
332. Gold quartz, Virginia Mine, Grass Valley, Nevada County.
927. Gold quartz, Williams' Mine, Tuolumne County.
1791. Gold in chalcedony, California (?).
2922. Model of gold nugget, found in Oregon Cañon, El Dorado County.
4813. Model of a gold bar, the result of one run made in the North Bloomfield Hydraulic Mine, Nevada County; weight, 6,117.78 ounces troy; gold, fine, 897; silver, fine, 93; total value, $114,280 72. This is probably the largest gold bar ever cast in the State.

SILVER.

In the early years of American occupation of our State the miner was so absorbed in gathering the rich harvest of gold, that he quite overlooked and even scorned metals of lesser value. The idea that California would eventually be a silver producing State never entered his mind. Yet it is now known that the State is rich in that metal, and it is a question if it will not soon vie with the more noble metal in importance and value.

Dr. Trask, the first State Geologist of California, was first to announce its presence in the State, but he little thought how great the development of mines of that metal would be within so few years. It is now known that silver mines occur in almost every county in the State from Del Norte to San Diego. The region lying east of the crest of the Sierra Nevadas bids fair to become a second Peru or Mexico. Every month new discoveries are announced, and the end is not yet.

The production of silver in California has been estimated at $26,000,000. An ideal cube representing that amount was placed on exhibition, as well as ores from all the principal silver mines of the State, which are shown in the following catalogue. The face of the silver cube was $12\frac{3}{10}$ feet nearly. A large output of this precious metal in the near future may be looked for with confidence:

Silver Mines and Silver Ores.

2009. Addenda Mine, five hundred foot level, Bodie, Mono County.

5325. Advance Mine, Coso District, near Darwin, Inyo County. Said to assay $3,000 per ton.

5065. Advance Mine, Monitor District, Alpine County.

2007. Ahuaga Mine, Tioga District, summit of Sierra Nevada Mountains, one mile and a half from Mount Dana, Mono County.

1804. Ahuaga Mine, summit of Sierra Nevada Mountains, one and one half miles northwest of Mount Dana.

5025. Alhambra Mine, Calico Mining District, San Bernardino County, breccia, coated with embolite.

43. Al. Bunnell Mine, Kern County.

140. Al. Bunnell Mine, Kernville, Kern County.

5328. American Flag Mine, Swansea District, Inyo County.

5164. Belle McGilivray Mine, near the surface, Providence Mountains, San Bernardino County.

5175. Belle McGilivray Mine, forty foot level, Providence Mountains, San Bernardino County.

5176. Belle McGilivray Mine, one hundred and twenty foot level, Providence Mountains, San Bernardino County.

4108. Beveridge District, Inyo County.

4128. Beveridge District, Inyo County, silver lead.

1634. Black Chief Mine, Mineral King District, Tulare County.

5321. Black Warrior Mine, Lookout District, Inyo County.

1638. Black Wolf Mine, Mineral King District, Tulare County.

1792. Bodie Mine, from the incline below the four hundred and thirty-three foot level, Bodie, Mono County, quartz crystals on silver ore.

4745. Bonanza King Mine, Slate Range, Inyo County.

5126. Bonanza King Mine, Bonanza King Consolidated Mining Company of New York, Providence Mountains, San Bernardino County; three hundred foot level, south winze.

5127. Bonanza King Mine, Providence Mountains, San Bernardino County; second winze, two hundred foot level (see No. 5126).

5128. Bonanza King Mine, Providence Mountains, San Bernardino County; third winze north, three hundred foot level.

5129. Bonanza King Mine, Providence Mountains, San Bernardino County; four hundred foot level.

5130. Bonanza King Mine, Providence Mountains, San Bernardino County; seventh winze, four hundred foot level.

5131. Bonanza King Mine, Providence Mountains, San Bernardino County; four hundred foot level, north.

5132. Bonanza King Mine, Providence Mountains, San Bernardino County; four hundred and fifty foot level.

5133. Bonanza King Mine, Providence Mountains, San Bernardino County; No. 4 winze, three hundred foot level.

5134. Bonanza King Mine, Providence Mountains, San Bernardino County; No. 4 winze, three hundred foot level.
5135. Bonanza King Mine, Providence Mountains, San Bernardino County; four hundred foot level, fine chloride ore.
3587. Brown Monster Mine, Inyo County, argentiferous galena, showing a radiated structure.
4739. Burning Moscow Mine, Calico District, San Bernardino County.
95. Calistoga Mine, Napa County.
2119. Caroline Mine, Deep Spring District, Inyo County.
558. Centennial Mine, Inyo County.
4280. Champion Mine, Prescott District, Mono County.
805. Chance Mine, Shasta County.
1635. Chihuahua Mine, Mineral King District, Tulare County.
2275. Cinderella Mine, Kern County.
25. Combination Mine, Desert Springs, Kern County.
67. Comanche Mine, Blind Springs District, Mono County, silver lead ore.
2918. Comanche Mine, Blind Springs, Mono County, native silver in partzite.
2919. Comanche Mine, Blind Springs, Mono County, partzite.
5318. Comstock Mine, Darwin District, Inyo County, silver lead ore.
3996. Concordia Mine, Bodie, Mono County, red silver ore.
2323. Deer Creek, Tulare County.
5323. Defiance Mine, Darwin District, Inyo County.
421. Diana Mine, Benton, Mono County.
4134. Ella Blossom Mine, Prescott District, head of Bloody Cañon, Mono County.
2814. Emigrant Mine, Lee District, Inyo County.
1640. Empire Mine, Mineral King District, Tulare County.
2008. French Flag Mine, Swansea District, Inyo County, silver lead ore.
4948. Garfield Mine, Calico District, San Bernardino County, rich silver ore, coated with embolite.
4279. Garibaldi Mine, Prescott District, Mono County, argentiferous galena, with blende and geocronite.
4737. Geneva Mine, Calico District, San Bernardino County.
2182. Gladiator Mine, Mazourka Cañon, Inyo County.
4964. Gobbler Mine. Calico Mining District, San Bernardino County.
4950. Golconda Mine, Calico District, San Bernardino County.
5057. Golden Crown Mine, Prescott District, Bloody Cañon, Mono County; formerly known as the "Antimony Mine."
150. Grand Mine, Coso District, Inyo County.
1120. Grand Mine, Inyo County, argentiferous galena.
4075. Grapevine District, San Bernardino County, embolite.
149. Great Eastern Mine, Panamint, Inyo County.
1098. Great Eastern Mine, San Bernardino County.
1641. Great Mogul Mine, Mineral King District, Tulare County.
345. Great Western Mine No. 1, Panamint, Inyo County.
319. Great Western Mine No. 2, Panamint, Inyo County.
422. Grey Eagle Mine, Benton, Mono County.
4969. Grigsby Mine, Calistoga, Napa County, rich in silver. A recent assay yielded 514 ounces to the ton.
1302. Hidalgo Mine, Inyo County, argentiferous galena.
331. Highland Mine, Panamint, Inyo County.
333. Huron Mine, Panamint, Inyo County,
2180. Indiana Mine, near Swansea, Inyo County, embolite.
2191. Indian Scout Mine, Deep Spring Valley, Inyo County.
1885. Iron Mountain Mine, Shasta County, section thirty-four, township thirty-three, range six west, Mount Diablo meridian. The silver is found in small nodules of sulphuret of iron. The locality and mode of occurrence have not yet been studied.
4230. Jones Mine, four miles from Angels, Calaveras County.
5073. Julia Mine, Lake District, Mono County, silver gold ore.
1793. Jupiter Mine, Bodie, Mono County, six hundred-foot level, north of the locality of No. 1792.
811. Kellenger and Lucy Mine, Copper City, Shasta County.
3541. Kentucky Mine, Sweetwater Range of Mountains, Mono County, horn silver.
256. Kerrick Mine, Benton, Mono County, partzite.
1580. Kidd Mine, six miles easterly from San Luis Obispo.
4736. King Mine, Calico District, San Bernardino County.
1637. Lady Emma Mine, Mineral King District, Tulare County.
1637. Lady Franklin Mine, Mineral King District, Tulare County.
2901. Leach Mine, Ord District, San Bernardino County.
5049. Lizzie Mine, west drift, Ivanpah, San Bernardino County.
961. Lone Star Claim, S. P. R. R. District, San Diego County, silver, lead, and gold ore.
4001. Lookout Mine, Lookout Mining District, Inyo County.
2813. Lucky Jim Mine, New Coso, Inyo County.
5062. Mammoth Mine, Lake District, Mono County.
4109. May Belle Mine, Bodie, Mono County.
2109. May Lundy Mine, Homer District, Mono County.

2078. Mineral Hill, Lake District, Mono County.
313. Minietta Belle Mine, argentite, Inyo County.
2517. Modesto Silver Mine, McGrear Flat, two and a half miles southwest of Sebastopol, Mariposa County.
1508. Modoc Mine, Inyo County, silver lead ore.
1581. Mountain Mystery Mine, six miles northeasterly from San Luis Obispo.
2038. Mount Dana Mine, two miles north of Bloody Cañon, Tuolumne County.
73. New Coso Mine, New Coso Mining District, Inyo County, argentiferous galena.
1119. New York Mine, Inyo County.
1545. Noonday Mine, Bodie, Mono County, argentiferous limestone; assay value, $35 to $50 per ton, two hundred foot level.
4740. Occidental Mine, Calico District, San Bernardino County.
5320. Old Dominion Mine, Snow's Cañon, Inyo County.
4074. Oriental Mine, Calico Mountain, San Bernardino County.
1561. Orient Mine, Bodie Mining Company, Mono County, silver gold ore.
1585. Oro Mine, Oro Mining Company, Bodie, Mono County.
2451. Oro Mine, Bodie, Mono County, pyrargyrite and proustite crystals in quartz.
5302. Oro Mine, Bodie, Mono County, silver-gold ore, three hundred and forty foot level.
5303. Oro Mine, Bodie, Mono County, four hundred and forty foot level.
5304. Oro Mine, Bodie, Mono County, five hundred and twenty foot level.
5305. Oro Mine, Bodie, Mono County, seven hundred and fifty foot level.
377. Pacific Mine, Piru District, Ventura County.
5319. Pacific Mine, Inyo County.
114. Panamint, Inyo County.
4947. Plutarch Mine, Calico District, San Bernardino County, embolite.
4912. Queen Mine, Calico Mining District, San Bernardino County, very rich, showing cerargyrite.
3718. Railroad Mine, Los Angeles, Los Angeles County.
2104. Redwood City Mine, San Mateo County, borings from a well, four hundred and seventy-eight feet below the surface. This specimen is rich in native or free silver. The presence of silver is very remarkable, and will be investigated at some future time.
1113. Resting Springs Mine, San Bernardino County.
5316. Richmond Mine, Deep Spring District, Inyo County.
378. Rose of Sharon Mine, Piru District, Ventura County.
4743. Run Over Mine, Calico District, San Bernardino County.
956. San Francisco Mine, Ivawatt District, San Bernardino County.
4735. San Gabriel Cañon Mines, San Bernardino County, contain native silver in calc spar and barite.
1544. Sigourney Mine, two and one half miles south of the Standard Mine, Bodie, Mono County, argentiferous limestone. This sample is thought to illustrate surface change from gold to silver-bearing rocks.
958. Silver Brick Claim, near Dos Palmos, San Diego County.
5055. Silver Lead Mine, Hornitos, Mariposa County.
1636. Silver Wealth Mine, Mineral King District, Tulare County.
4072. Small Hill Mine, Santa Catalina Island.
4281. Snowdrift Mine, Prescott District, Mono County.
1584. Soper Consolidated Mine, six miles northeasterly from San Luis Obispo.
5063. Tarshish Mine, Monitor District, Alpine County, silver ore with enargite.
104. Tiger Mine, Coso District, Inyo County.
2917. Tower Consolidated Mine, Indian Creek District, Mono County, partzite, native silver, galena, etc.
5311. Trade Dollar Mine, Deep Spring District, Inyo County.
5315. Trade Dollar No. 2 Mine, Deep Spring District, Inyo County.
4111. True Blue Mine, Mono Lake District, Mono County.
4704. Twins Mine, three miles southeast of Calistoga, Napa County.
2183. Union Mine, twelve miles south of Independence, Inyo County.
5064. Valentine Mine, Old Coso, Inyo County, silver gold ore.
5322. Variety Mine, Darwin District, Inyo County.
4952. Veto Mine, Calico Mining District, San Bernardino County.
1583. Victoria Mine, six miles northeasterly from San Luis Obispo.
4063. Walhall Mine, Calico Mountain, San Bernardino County.
1579. Washington Mine, six miles northeasterly from San Luis Obispo.
3425. Waterman Mine, Grapevine District, San Bernardino County.
4234. Waterman & Porter Mine, Grapevine District, San Bernardino County, free silver in gangue of barite.
1582. Whig Mine, six miles northeasterly from San Luis Obispo.
1412. Whiteman Mine, Deep Spring Valley, Inyo County.
2185. Wonder Mine, White Mountains, thirty-five miles north of Independence, Inyo County.
91. Wyoming Mine, Panamint, Inyo County, silver copper ore.
1503. Ygnacio Mine, Cerro Gordo District, Inyo County.
2184. Zulu Mine, Deep Springs District, Inyo County.

QUICKSILVER.

Were it not for the peculiar properties of this most singular metal gold would be still more difficult to gather than it is. Mercury is the only metal known to the inhabitants of this earth, at the present time, that is liquid at ordinary temperatures. It has the property of forming intimate and almost instantaneous association with certain metals, including gold, while it wholly rejects others. It has the property also of becoming a vapor at a temperature much below that of red hot iron. In this condition it can be conveyed in pipes and condensed to a fluid again. It is these properties that render mercury so valuable or invaluable in mining and metallurgy. This metal has been enormously produced, used, and wasted in California. The figures that show this are almost startling, amounting as they do to twenty-seven times the weight of the gold obtained in the State.

Large quantities are sent to other mining districts, both at home and abroad, while a considerable portion is used in the manufacture of calomel, corrosive sublimate, vermilion, mercurial ointment, and other preparations, while some is utilized in gilding, backing for mirrors, clock weights, barometers, and electrical apparatus, and in other minor ways.

The following estimate of the product of quicksilver in California was made by Mr. J. B. Randol, of the New Almaden Mine, the most productive in America, and ranking No. 3 among the mines of mercury in the world. The large sample shown in the Exposition, in which a cannon ball floated, was furnished by that gentleman.

The total product from 1850 to 1883, inclusive, was 1,357,403 flasks of $76\frac{1}{2}$ pounds each. This is equal to 103,841,329 pounds, or $51,920\frac{1329}{2000}$ tons. The principal ore from which this metal is obtained is cinnabar, or the sulphide of mercury. It is sometimes found in a metallic state, but not in any considerable quantity. The greater proportion is obtained from very low grade ores, which are treated in very extensive and very expensive furnaces.

The following quicksilver mines and ores were represented:

Quicksilver Mines, and Quicksilver Ores.

446. California Quicksilver Mine, Yolo County, cinnabar, three hundred feet from surface.
540. California Quicksilver Mine, Yolo County, crystallized metacinnabarite.
447. California Quicksilver Mine, Dublin Tunnel, Yolo County, cinnabar, one hundred and fifty feet from surface.
61. Clear Quill Mine, Greeneville District, Sonoma County, one mile from Great Eastern mine, quicksilver.
2269. Coast Range, Kern County, concretionary cinnabar.
487. Eclipse Tunnel, one hundred and thirty feet from mouth, Lake County, cinnabar.
288. El Dorado County, cinnabar.
2744. Great Eastern Mine, Sonoma County, two hundred and forty foot level.
122. Guadalupe Mine, near San José, Santa Clara County, cinnabar, and pyrites.
560. Guadalupe Mine, Santa Clara County, cinnabar, and quartz.
1291. Guadalupe Mine, Santa Clara County, cinnabar.
2279. Guadalupe Mine, Santa Clara County, calcite in ore of cinnabar.
2280. Guadalupe Mine, Santa Clara County, burnt rock.
2281. Guadalupe Mine, Santa Clara County, soot from condensers and furnaces.
2338. Guadalupe Mine, Santa Clara County, rich cinnabar, from different levels, from the surface to one thousand two hundred feet.
2417. Guadalupe Mine, Santa Clara County, croppings.
3730. Guadalupe Mine, Santa Clara County, cinnabar (concentrated from low grade ores).
4929. Guadalupe Mine, Santa Clara County, crystallized cinnabar, in crystallized calcite.
1550. Josephine Mine, San Luis Obispo County, township twenty-seven south, range ten east, Mt. Diablo meridian.
1551. Libertad Mine, San Luis Obispo County, township twenty-seven south, range ten east, Mt. Diablo meridian.
4349. Lake Quicksilver Mine, Lake County, quicksilver ore, with chalcedony and stib-

nite (sulphide of antimony). The mine joins the Manhattan, a well known quicksilver mine, and the above is from a depth of sixty feet. This specimen shows the association of antimony and mercury, which is common not only in California, but in other localities.

180. Los Preitos Mine, Santa Barbara.
2869. Manzanita Mine, Sulphur Creek, Colusa County, cement gravel with cinnabar.
1696. Napa Consolidated Mine, Oat Hill, Napa County, cinnabar in sandstone.
1727. New Almaden Quicksilver Mine, Santa Clara County, quartz, cinnabar, and vein-matter.
1728. New Almaden Mine, Santa Clara County, vein-matter and crystallized cinnabar.
1729. New Almaden Mine, Santa Clara County, cinnabar, native mercury, and vein-stone.
1730. New Almaden Mine, Santa Clara County, dark variety of cinnabar.
1731. New Almaden Mine, Santa Clara County, light or vermilion variety of cinnabar.
1732. New Almaden Mine, Santa Clara County, cinnabar, bitumen, and calcite.
1733. New Almaden Mine, Santa Clara County, cinnabar, vein stone, and alta, showing the junction of the alta and vein—the alta being the country rock of the hanging wall.
1735. New Almaden Mine, Santa Clara County, roasted ore.
1736. New Almaden Mine, Santa Clara County, adobe, ready for the furnace.
1737. New Almaden Mine, Santa Clara County, adobe roasted.
1738. New Almaden Mine, Santa Clara County, soot from condensers.
1739. New Almaden Mine, Santa Clara County, quicksilver.
5347. New Almaden Mine, Santa Clara County, cinnabar, weight 290 pounds.
1275. New Idria Mine, Fresno County, cinnabar with bitumen (aragotite).
2747. Oat Hill Mine, near Pope Valley, Lake County, cinnabar in sandstone.
143. Oakland Mine, Sonoma County.
280. Oceanic Quicksilver Mine, San Luis Obispo County, cinnabar.
1223. Old Chapman Mine, Santa Clara County, rock containing cinnabar.
4355. Old Napa Con. Quicksilver Mine, Pope Valley, Napa County, cinnabar and calcite.
317. Phœnix Quicksilver Mine, twenty miles from St. Helena, head of Pope Valley, Lake County, cinnabar.
552. Pomposa Mine, Santa Barbara County, cinnabar.
349. Sulphur Bank Quicksilver Mine, nine miles northwest from Lower Lake, Lake County.
484. Sulphur Bank Mine No. 2, Lake County, obsidian, sulphur, and cinnabar.
1109. Sulphur Bank Mine No. 2, Lake County, cinnabar and obsidian.
1219. Sulphur Bank Mine, Lake County, cinnabar and sulphur.
1221. Sulphur Bank Mine, Lake County, cinnabar.
4080. Sulphur Bank, Lake County, cinnabar, obtained in refining sulphur from Sulphur Bank before it was known to be a valuable quicksilver mine.
4135. Sulphur Bank, Lake County, cinnabar, separated in refining sulphur. (See No. 4080.)
1261. Uncle Sam Quicksilver Mine, Clear Lake, Lake County, earth with quicksilver.
45. Wall Street Mine, Lake County, cinnabar.
63. Wall Street Mine, Lake County, native quicksilver.
1173. Wall Street Mine, Lake County, quicksilver ore containing free mercury and cinnabar.
3677. Washington Mine, Napa County, concretionary cinnabar.
454. Wright Tunnel, California Quicksilver Mine, Yolo County, cinnabar.

COPPER.

Ores of this metal are found in abundance in California. Owing to reasons before stated the lesser valued metals have not been extensively mined, still considerable quantities of this useful metal have been furnished to the world from our State. During the year 1883 metallic copper, or its equivalent in ores, to the extent of 700 tons, was shipped from California. In 1882, there were shipped from San Francisco to England by sea 864,700 pounds of copper ore, and by rail to the East 126,541 pounds of copper, 1,795,107 pounds of copper cement, and 100,000 pounds of copper ore. The shipments since the dates mentioned have been somewhat larger, but we have not any exact figures or reliable estimates at hand at present.

The value of low grade copper ore has been learned, and great stores of copper lie dormant in such ores, which will eventually be extracted, giving employment to capital and labor in the State, and adding an important and valuable product to commerce and manufactures.

The following localities and mines were represented at the Exposition:

Copper Mines and Copper Ores.

812. Afterthought Mine, Shasta County, melaconite.
2442. American Mine, Candace Consolidated Mining Company, Colusa County.
4351. Beveridge District, Inyo County.
4461. Buchanan Mine, Fresno County.
4485. Bullion District, Plumas County, principally chalcopyrite.
342. Calaveras County.
3017. Campo Seco, Calaveras County, chalcopyrite. Taken from a large quantity at Milton, awaiting shipment.
2439. Candace Mine, Colusa County, cuprite and native copper.
2047. Cedar Mine, twelve miles above Grass Valley, Nevada County.
1889. Cedar Mine, Nevada County, copper ore with free silver. Two specimens; the smaller specimen is remarkable.
804. Copper City, Shasta County, chalcopyrite, erubescite, and pyrites.
801. Copper Hill, Shasta County.
5026. Copper World Mine, Clark's Mining District, San Bernardino County, chrysocolla (silicate of copper).
5028. Copper World Mine, Clark's Mining District, San Bernardino County, copper ore.
5158. Copper ore (cuprite), in beautiful microscopic crystals, with chrysocolla and threads of cerargyrite. There is said to be a large deposit of this mineral near Lundy, Mono County.
2738. Cosumnes Copper Mine, Amador County.
684. Del Norte County.
126. Diamond Mine, Del Norte County.
2880. Eagle Copper and Silver Mining Company, Quail Hill, Calaveras County.
5434. Engel's Copper Mine, Light's Cañon, Plumas County, chrysocolla and malachite in alternate layers, surface botryoidal, and coated with malachite.
5435. Engel's Copper Mine, Light's Cañon, Plumas County, erubescite (bornite).
4486. Enterprise Mine, Bullion District, Plumas County, chalcosite.
2441. Fortuna Mine, Candace Consolidated Mining Company, Colusa County.
4257. Genesee Valley, Plumas County.
5326. Grand Mine, Darwin District, Inyo County.
151. Great Republic Mine, Mount Diablo, Contra Costa County, two specimens.
152. Great Republic Mine, Mount Diablo, Contra Costa County, copper bars.
472. Green Vein, Hamlington's District, Mariposa County.
196. Grizzly Mine, eighteen miles northwest of Healdsburg, Sonoma County.
2137. Grizzly Den Mine, San Luis Obispo County.
2181. Hirsch Mine, nine miles southeast of Independence, Inyo County; same ledge as Old Eclipse. This specimen is principally cuprite.
475. Hunter's Valley, Mariposa County.
685. Ione District, Amador County.
2401. Iron Mountain, near Shasta, Shasta County.
2435. Iron Mountain, Shasta County, azurite, malachite (carbonates of copper), and cuprite (oxide of copper).
2350. Ivanpah District, San Bernardino County, azurite (blue carbonate of copper).
802. Kellenger Mine, Copper Hill, Shasta County.
671. Kentucky Mine, Calaveras County.
4746. Kerrick Mine, Benton, Blind Springs, Mono County, azurite, malachite, and cuprite.
2440. Lellia Mine, Candace Consolidated Mining Company, Colusa County.
4137. Near Lexington, Santa Clara County, chalcopyrite.
1770. Near Lincoln, Placer County, cuprite, malachite, and native copper.
246. Los Angeles County, copper glance.
672. Lost Mine, thirty miles west of the Colorado River, San Diego County, copper ore, malachite, cuprite, azurite, and chrysocolla.
3714. Mammoth Copper Mine, Mono County, principally cuprite.
77. Mariposa County, near Hornitos, chalcopyrite.
2358. May Flower Mine, Mineral King District, Tulare County, cuprite.
4653. Meadow Lake, Placer County, native copper, with cuprite (red oxide of copper).
1656. Mineral Point Lode, thirty miles east of Crescent City, Del Norte County, samples of copper ore with metallic copper reduced from it.
2169. Modoc Mine, Inyo County, azurite (blue carbonate of copper).
2797. Mono Lake, Mono County, cuprite.
2894. Morning Star Mine, Rockland District, Del Norte County.
3696. Mountain Gem Mine, Genesee, Plumas County.
3735. Napa County, native copper.
4223. Native copper, with copper minerals, in a gangue of sulphate of baryta, with specimen mounted for microscopic examination, from a ledge in the southern corner of Trinity County. The ledge is said, by the donor, to be very prominent, and can be seen running in a straight line for twenty miles from the south toward Mount Shasta.
1771. Nickerson Mine, Nevada County, chalcopyrite in quartz.
691. Noble Mine, Amador County.

800. Peck Mine, Copper Hill, Shasta County, azurite.
803. Peck Mine, Copper Hill, Shasta County, copper ore.
806. Peck Mine, Copper Hill, Shasta County, cuprite, microscopic crystals.
808. Peck Mine, Copper City, Shasta County, chalcanthite.
816. Peck Mine, Copper Hill, Shasta County, carbonate of copper.
4274. Phelps' Springs, Stony Creek, Colusa County, chalcopyrite.
3358. Pioneer Mine, Bolinas Bay, Marin County. Assay: gold, trace; silver, twenty-two dollars per ton; copper, ten per cent.
4898. Ravenna, Los Angeles County.
3369. Reward Mine, Genesee Valley, Plumas County, rich copper ore, principally cuprite.
118. San Bernardino County, copper ore.
4387. San Francisco Copper Mine, Spenceville, Nevada County, principally chalcopyrite.
4388. San Francisco Copper Mine, Spenceville, Nevada County, copper matte, concentrated by roasting in heaps, allied to erubescite; by this process the rich copper matte forms a kernel in a mass of protoxide of iron.
4389. San Francisco Copper Mine, Spenceville, Nevada County, copper ore roasted.
4390. San Francisco Copper Mine, Spenceville, Nevada County, copper cement, metallic copper in the form of a powder, precipitated from solution by scrap iron; iron replaces the copper in the solution, forming sulphate of iron, while the copper falls; is dried and shipped to a market.
2136. St. Katherina Mine, San Luis Obispo County.
2331. Santa Amedio Rancho, Coast Range, cuprite, melaconite, malachite, and calcite.
54. Skaggs' Springs, Sonoma County, carbonate ore.
700. Surprise Mine, Mount Diablo, Contra Costa County.
2412. Sweetland Creek Mine. Nevada County, copper shale.
1751. Telegraph Mine, Hog Hill, Calaveras County, native copper and azurite.
4456. Trinity County, cuprite with native copper.
314. Union Mine, Copperopolis, Calaveras County, chalcopyrite.
1433. Union Mine, Inyo County, chrysocolla—silicate of copper.
1499. Union Mine, Inyo District, Inyo County, azurite (carbonate of copper) with galena.
2179. Ygnacio Mine, Cerro Gordo District, Inyo County, azurite (blue carbonate of copper).

IRON.

Iron ores are quite abundant in the State and are of good quality, but it is only lately that they have been worked to any considerable extent. There is one well appointed charcoal blast furnace in operation, but as to the total production there are no reliable figures at hand, nor can information be given as to the cost of production or the financial success of the enterprise, but there is no question as to the excellent quality of the iron produced.

The output has been estimated at 25,000 tons. Should suitable coal be discovered in the State the iron industries would soon grow into great importance, and, as it is, it will probably be found possible to import coke or coal, or both, at a rate sufficiently low to admit of a much larger production.

The California Iron and Steel Company made a special exhibit of the products of this furnace as follows:

Pig iron, Clipper Gap furnace, Nos. 1, 2, 3, 4, and 5. Each representing a different quality.
Samples of iron ore, Lime Quarry Workings, Shaft No. 3, three specimens.
Samples of iron ore, Shaft No. 1, several specimens.
Limestone or marble used as a flux.
Specimen of slags, etc.

These specimens were donated to the National Museum at Washington, by special request.

The following iron ores and minerals from the State Museum were exhibited:

Iron Ores.

2336. Hematite, Alameda County.
2833. Earthy hematite, Monitor, Alpine County.
4987. Hematite, Jackson, Amador County.
87. Hematite, Ione Valley, Amador County.
4652. Iron ore (hematite), from a ledge said to crop out 800 feet in length, near the Amador Gravel Mine, two and a half miles northeast from Jackson, Amador County.

3750. Hematite, nodule (hollow), near Volcano, Amador County.
2885. Hematite (micaceous iron), Feather River, near Oroville, Butte County.
3766. Iron ore (hematite), Big Tree Iron Mine, Calaveras County.
3367. Hematite. Township four north, range ten east, opposite section three, in unsurveyed land, two miles southeast of Campo Seco, Calaveras County. Said to be in large quantities, and to be of easy access.
4356. Hematite, Diamond Springs Township, El Dorado County. The following information is furnished with the specimen: One thousand tons shipped to San Francisco several years ago, were used in the manufacture of iron. The deposit is sixty feet wide; a ledge of marble runs parallel and some distance to the east, say one hundred feet. The block of marble which California sent to the Washington monument came from this ledge. A tunnel is driven in about one hundred and twenty feet, which cuts the ledge sixty feet below the surface. At another point they have sunk a shaft about forty feet, all in ore. Plenty of wood for charcoal. Water costs five cents per inch. Charcoal is now worth fifteen cents—could be furnished for eight cents per bushel.
1606. Hematite, red, used as a pigment by the Indians of Owen's River Valley, Inyo County.
3761. Iron ore (hematite), near St. Helena, Napa County.
3773. Iron ore (hematite), Holden Ledge, township fifteen north, range seven east, Mount Diablo meridian, Nevada County.
1861. Hematite (ochrous), Clipper Gap Iron Mine, section twenty-four, township thirteen north, range eight east, Mount Diablo meridian, Placer County.
1860. Hematite, Clipper Gap Iron Mine, section twenty-four, township thirteen north, range eight east, Mount Diablo meridian, Placer County.
1937. Hematite, from Red Hill, section fifteen, township thirteen north, range eight east, Mount Diablo meridian, Placer County, California Iron Company.

Analysis.

Silica		33.10
Water	Hygroscopic	2.90
	Combined	6.45
Sesquioxide of iron		55.25
Lime		1.65
Sulphur		Trace.
Phosphorus		Trace.
		99.35

This ore contains 38.68 per cent. of iron.

3361. Hematite and magnetite, near Crescent Mills, Plumas County.
4382. Hematite and limonite, Potter's Iron Mine, bank of Pit River, one mile from the fisheries, Shasta County.
4731. Limonite, concretions of, found near Pine Grove, Amador County, first thought, by their external appearance, to be coprolites; No. 4332, which is the same, was so labeled.
4887. Limonite, after pyrite, Red Hill, Butte County.
2455. Limonite, between Jenny Lind and Campo Seco, Calaveras County. Occurs on the top of a round hill, cropping twelve feet above ground and fifteen feet wide, large quantity on the surface.
3760. Limonite and hematite, San Andreas, Calaveras County.
3765. Limonite, Iron Monarch Mine, Campo Seco Township, Calaveras County.
4469. Limonite, near Murphy's, Calaveras County.
553. Limonite, Murphy's, Calaveras County.
3763. Iron ore (limonite), township four north, range ten east, Mount Diablo meridian, opposite section three, in unsurveyed land, two miles in a southerly direction from Campo Seco, Calaveras County.
1896. Hematite, occurs in the rock formation, Kelsey Tunnel, fourteen miles southeast of Cresent City, Del Norte County.
4148. Limonite, near Latrobe, El Dorado County. Vein twenty feet wide. Plenty of wood, water, and limestone. Analysis: Sesquioxide of iron, 78.27; protoxide of iron, 0.80; silica, 6.51; water, 14.75; sulphur, 0.57; phosphorus, 0.02; total, 100.92; metallic iron equals 55.41 per cent.
3717. Limonite, after pyrite, perfect crystals, Chowchilla Valley, Mariposa County.
2397. Limonite concretions, Forest Hill, Placer County.
5426. Impure limonite, after pyrite, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
1552. Limonite, or Hematite, Harrington Iron Mine, San Luis Obispo County, four miles southwest of the City of San Luis Obispo, on subdivision of the Rancho Cañada de Los Osos, township thirty-one south, ranges eleven and twelve east, Mount Diablo meridian. The ledge has a northwesterly direction, with a dip to the west. Supply of ore seemingly inexhaustible. An assay has been made, showing eighty-five per cent of metallic iron.
3762. Iron ore (limonite), San Luis Obispo County, on the line of Monterey County.
2790. Limonite and psilomelane, Santa Clara County.
4936. Limonite, iron ore, Hahn's Ranch, twelve miles south of the Guadalupe Quicksilver Mine, Santa Clara County.
5906. Limonite (botryoidal), eighteen miles south of Redding, Shasta County.

3002. Limonite, Gold Lake, Sierra County.
3774. Limonite, twenty-five miles east of Visalia, Tulare County. Good road, plenty of wood and limestone. Mine lies between two rivers.
2267. Limonite, near Visalia, Tulare County.
65. Magnetite, Sutter Creek, Amador County.
2788. Magnetite, Oroville, Butte County.
301. Magnetite, Butte County.
1667. Magnetite, near Big Red Ravine, two miles from Coloma, El Dorado County.
4254. Iron ore (magnetite), Clarksville, El Dorado County.
689. Impure Magnetite, Green Valley, El Dorado County.
965. Magnetite, El Dorado County, two miles northwest of Shingle Springs.
4644. Magnetite, thirty miles north of Los Angeles, Los Angeles County.
1996. Magnetite, Coulterville, Mariposa County.

Analysis.

Silica	15.50
Sesquioxide of iron	77.78
Protoxide of iron	7.39
Sulphur	Trace.
	100.67

3006. Magnetite in gangue (epidote?), base of Mount Hoffman, Mariposa County.
3005. Magnetite, base of Mount Hoffman, south side of the dividing ridge between Mariposa and Tuolumne Counties.
3768. Iron ore (magnetite), near Benton, Mono County. Analysis by Falkenau & Reese: Peroxide of iron, 93.00; silica, 7.00; traces of sulphide of copper. This ore is said to be in very large quantities.
3639. Magnetite, Solid Iron Mine, Indian District, Mono County. Analysis by Faulknau & Reese: Peroxide of iron, 93.00; silica, 7.00; total, 100.00; graphite and sulphide of copper, traces.
3757. Magnetite, near St. Helena, Napa County.
3767. Magnetite, Grass Valley, Nevada County.
1333. Magnetite, in dodecahedral crystals, six miles from Placer County.
3585. Magnetite, near the New England Mills, Placer County.
1938. Magnetite, section fifteen, township thirteen north, range eight east, Mount Diablo meridian, Placer County, California Iron Company.

Analysis.

Silica	3.23
Sesquioxide of iron	80.05
Protoxide of iron	17.06
	100.34

This ore contains 69.29 per cent of iron.

117. Magnetite, Feather River, near Gold Lake, Plumas County.
819. Magnetite, Tres Pinos, San Benito County.
2274. Magnetite, Coast Range Mountains, San Benito County.

Analysis.

Water	.15
Silica	14.70
Sesquioxide of iron	65.40
Protoxide of iron	18.72
Sulphur	Trace only.
	98.97

4344. Magnetite, magnetic iron ore, San Benito County, fourteen miles from Hollister, sections thirty-one and six, township sixteen south, range six east, San Benito Iron Mine; occurs in large quantities, with limestone.
3759. Magnetite, San Bernardino County, six miles from water,
2886. Magnetite, eight or nine miles north of Mesquite Station, San Diego County.
3756. Magnetite, Mohawk Valley, Sierra County.
2055. Magnetite, Iron Mountain, near Shasta, Shasta County.
20. Magnetite, McCloud River, Shasta County.
1709. Magnetite, Iron Mountain Mine, seven miles from Shasta, Shasta County.
1761. Magnetite, Potter's Iron Mine, Shasta County. Occurs in large quantities at a locality about two miles southeast of the United States Salmon Fishery on the McCloud River, joining an immense limestone formation which crops out one thousand feet high, and extends along the river for four miles. There is an abundance of wood suitable for charcoal, and unlimited water power.

Analysis.

Silica	00.49
Ferrous oxide	19.59
Ferric oxide	79.90
	99.98

Contains 71.16 per cent iron.
579. Magnetite, Yuba County.
3712. Siderite (carbonate of iron), Tejunga Cañon, Los Angeles County. Occurs in a quartz ledge, country rock, granitic.
4907. Bog iron ore, found five miles from Alameda, Alameda County.
1712. Iron ore (oxide), average from tunnel, Iron Mountain Mine, seven miles from Shasta.
4082. Iron ore (pyritic), Laurel Hill, Mono County.
19. Iron ore, McCloud River, Shasta County.
4058. Iron ore. Said to occur in large quantities one mile east of Sperry's Hotel, Murphy's, Calaveras County. Lies between belts of limestone and slate. Plenty of wood and water.
3764. Jaspery iron ore, near Campo Seco, Calaveras County.
3422. Jaspery iron ore, northwest corner of Sonoma County, near Point Arena.
4083. Iron, reduced from ore in a common crucible; mistaken for tin.
4019. Iron buttons, obtained in crucibles from the Campo Seco iron ore, Calaveras County.
3758. Metallic iron (reduced from magnetite), found near St. Helena, Napa County.

Lead and Base Bullion—(Lead containing Gold, Silver, and Copper).

Lead ranks high as one of the mineral products of the State. The metal obtained by the crude processes is seldom so free from other metals as to be sold for pig lead, but is generally to a greater or less extent mixed with metals of greater value or otherwise, and is placed in the market as "base bullion" and sold to refiners as such. From 1878 to 1883 the yield in pounds was as follows:

Base bullion	45,846,800	
Lead	32,011,700	
	77,858,500	Equal to 38,929$\frac{500}{2000}$ tons.

Lead Minerals and Mines Producing Lead Ores Represented.

There are no lead mines in California, strictly speaking. All the ores of lead which have been discovered are associated with other metals, as gold, silver, copper, antimony, etc. The following specimens were exhibited:

429. Cerro Gordo, Inyo County, lead stalagmite, droppings from furnace.
4211. Hidalgo Mine, Inyo County, fine grained galena.
1394. Homer Mill and Mining Company, Mono County, galena ore.
5313. Leadville Mine, Inyo County, galena.
2112. May Lundy Mine, Homer District, Mono County, galena. See No. 2109.
1647. Modoc Mine, Inyo County, azurite, anglesite, and bindheimite.
1648. Modoc Mine, Inyo County, anglesite and bindheimite.
1653. Modoc Mine, Inyo County, galena.
2168. Modoc Mine, Inyo County, anglesite, sulphate of lead.
915. New Coso Mine, Inyo County.
1105. New Coso Mine, Inyo County, galena.
295. San Bernardino County, galena.
130. San Bernardino County, litharge.
673. Santa Catalina Island, Coast of California, galena.
4071. Small Hill Mine, Santa Catalina Island, galena.
1880. Sunrising Mine, near Aqueduct City, Amador County, galena in quartz.

Chrome Ores.

Mines of chrome are never in California designated by special names, like those of gold, silver, copper, lead, etc. The reason for this is that the ore is found in bunches and deposits, which are after a time exhausted, and new localities are sought.

3716. Chromic iron, within one mile of Auburn, Placer County.
4470. Chromic iron, near Murphy's, Calaveras County.
174. Chromic iron, Cloverdale, Sonoma County.
4747. Chromic iron, eighteen miles east of Crescent City, Del Norte County.
1402. Chromic iron, El Dorado County, one mile and a half from railroad.

1906. Chromic iron, seven miles east of Folsom, Sacramento County.
1365. Chromic iron, five samples, from as many different deposits within twenty miles of Fresno City, Fresno County.
3725. Chromic iron, near Iowa Hill, Placer County.
1876. Chromic iron, near Jackson, Amador County.
2431. Chromic iron, near Latrobe, El Dorado County, ledge said to be three to six feet thick.
6. Chrome iron, Litton Springs, Sonoma County.
4903. Chromic iron, near Livermore, Alameda County.
2343. Chromic iron, four and a half miles northeast of San Luis Obispo.
1154. Chromic iron, Los Gatos, Santa Clara County.
3711. Chrome iron, Michigan Bluff, Placer County.
4678. Chromic iron, Mount Hope District, near Forbestown, Butte County.
4196. Chromic iron, near Mountain House, near Downieville, Sierra County.
2731. Chromic iron, one mile south of Mountain Spring House, Amador County.
5120. Chromic iron, southeast quarter of section twenty-one, township fourteen north, range nine east, Placer County.
5050. Chromic iron, found within two or three miles of Nevada City, Nevada County.
1578. Chromic iron, Pick and Shovel Mine, six miles northeast from the City of San Luis Obispo. Direction of the vein, northeast to southwest, dips west forty-five degrees. Ore extracted to July, 1880, four hundred tons.
2493. Chromic iron, ten miles from Portersville, Tulare County.
686. Chromic iron, within six miles of San Francisco.
4640. Chromic iron, found on the road from St. Helena to Knoxville, Lake County, said to exist in large quantities.
797. Chromic iron, near St. Helena.
173. Chromic iron, San José, Santa Clara County.
394. Chromic iron, five miles east of San José, Santa Clara County.
57. Chrome iron, twelve miles from San Juan, San Luis Obispo County.
322. Chromic iron, San Luis Obispo.
2526. Chromic iron, San Mateo County, Pacific slope of the Redwoods, chromic acid 50.12 per cent.
960. Chromic iron, two miles northwest of Shingle Springs, El Dorado County.
2772. Chromic iron, Solano County, near Fairfield.
2768. Chromic iron, near South Fork of American River and nine miles from Folsom. Two thousand tons have been shipped from this mine.
923. Chromic iron, Tuolumne County.
3601. Chrome iron of high grade, from within half a mile of the town of Yreka, Siskiyou County.

HYDROCARBONS AND MINERAL FUELS.

Coal and Lignite.—While it cannot be denied that true coal does not exist in the State, or at least has never been discovered, yet a fair quality of lignite has been somewhat largely produced, which takes the place, to a certain extent, of the more valuable and useful coal, and which, although a rather poor substitute, is better than no fuel and serves many useful purposes. From 1860, to June, 1884, the yield of the Mount Diablo Mines alone was 2,570,461 tons.

Petroleum.—In view of the fact that California is poor in natural fuels of the nature of coals or lignites, it is a matter for congratulation that petroleum is likely to be largely produced in the State. The area over which petroleum, asphaltum, maltha, and other hydrocarbons are found is large. Already 388,000 barrels of crude oil have been pumped from the various wells. This oil is becoming more and more generally utilized.

Asphaltum is mined and used quite extensively in California. The annual consumption and production is estimated at 3,500 tons, and the price is from \$9 to \$11, according to quality and market. Considerable attention has been paid to its use for pavements, and a number of useful inventions have been made.

Robert Skinner, of San Francisco, invented a process for manufacturing an asphalt pavement-block by compression, which is briefly described as follows: Calcareous material, after being crushed, is heated and brought in contact with hot asphaltum. This material is then forced into molds under a pressure of not less than 50 tons, after which, having been cooled in water, it becomes homogeneous. A block manufactured by this method (3606),

was exhibited at the Exposition, and it was a pleasure to learn that the walks in front of the main building were laid in these blocks and that they gave great satisfaction. The street pavements laid in New Orleans are better than those of San Francisco. St. Charles Avenue, from Lee Circle to Carrolton, was being laid during the Exposition, and I watched the operation with great interest. The work was being done by an eastern company; the operation was as follows: The ground was first leveled and compacted by passing over it a very heavy iron roller; on this was laid a thick stratum of concrete, consisting of broken stones and hydraulic cement; plenty of time is allowed for this to set. The asphalt is prepared in a special temporary building placed in a convenient position near the work. The crude asphaltum is "cooked" for 72 hours; this operation yields a product which is called "refined." The next process is to place the refined asphaltum in large kettles with a certain proportion of crude petroleum; it is then discharged into a mechanical mixer and five parts of sand added, previously heated to remove moisture; the whole is thoroughly mixed by revolving rollers with blades. While this is going on, limestone is ground to flour and added in the proportion of one sixth; when still further mixed the substance is discharged into an iron cart and quickly driven to the work. When the load is dumped on the surface of the hardened concrete it is spread with hoes and rolled with an iron roller. The operation produces a most beautiful roadway, and from its very nature must be durable.

The following specimens of hydrocarbons and mineral fuels were shown:

Hydrocarbons.

338. Aragotite, a new hydrocarbon, California Quicksilver Mine, Yolo County. See proceedings California Academy of Sciences, vol. 4, p. 218.

156. Asphaltum, one half mile from San Luis Obispo.

328. Asphaltum pierced by shells, Los Angeles County.

543. Asphaltum, Santa Barbara County.

4151. Asphaltum nodules or water-worn bowlders, found on the beach at Santa Barbara.

5638. Asphalt (brea), found in large quantities at Petrolia, section five, township three, range nine west, seven miles from Anaheim, Los Angeles County.

5059. Asphaltum, solid, from a natural well, Steele's Ranch, San Luis Obispo County (see No. 5058).

5058. Asphaltum, liquid, from a natural well, said to be one hundred feet deep, from which it overflows and becomes solid asphaltum, Steele's Ranch, San Luis Obispo County.

5633. Asphalt, liquid, or maltha. Tar Creek, near Sargent, Santa Clara County. This substance flows from the earth in many places and hardens into solid asphalt (see No. 5634); specific gravity, 1.143.

5634. Asphaltum, called by the Mexicans "brea," Spanish for "pitch," found in large quantities at Tar Creek, near Sargent, Santa Clara County. It results from the inspissation of the liquid (No. 5633).

5635. Asphaltum, block, refined from No. 5634 by heating and straining, used for street pavements, roofs, etc., Tar Creek, near Sargent, Santa Clara County.

5636. Asphaltum, refuse in refining crude material (No. 5634), Tar Creek, near Sargent, Santa Clara County.

5637. Asphaltum, free from sand, and otherwise nearly pure; natural result of inspissation of liquid asphalt or maltha (No. 5633). This mineral resembles the purest asphalt from Trinidad, or the Dead Sea; specific gravity, 1.15; Tar Creek, near Sargent, Santa Clara County.

5639. Asphalt, liquid, or maltha, from one of the oil wells at Petrolia, section five, township three south, range nine west, seven miles from Anaheim, Los Angeles County; specific gravity, .969.

5640. Asphalt, liquid, or maltha, from the Puente oil wells, section one, township three south, range ten west, seven miles from Anaheim, Los Angeles County; specific gravity. .920.

110. Bituminous shale, Monterey County.

1264. Bituminous earth, Kelseyville Gas Wells, Lake County.

1740. Bitumen, New Almaden Quicksilver Mine, Santa Clara County.

4755. Bituminous shale, or impure lignite, near Mount Diablo, Contra Costa County. Volatile matter, including water, 24.4; fixed carbon, 17.6; ash, 58.0; total, 100.

5045. Brown lignite (5-foot vein), Temescal Mountains, 25 miles southwesterly of Colton, San Bernardino County, owned by McIntosh & Chaney. Fixed carbon. 27.74; combustible matter, 32.26; water, 20.00; ash, 20.00—100.

2806. Cake of paraffine, from California petroleum.
431. Coal, vein four feet thick, two and a half miles from Carmelo Bay, Monterey County.
987. Coal, Spinks Coal Mine, Lincoln, Placer County.
1301. Coal with gypsum, Antioch, Contra Costa County.
1358. Coal (?), Kelseyville, Lake County.
1800. Coal, thirty-inch vein, Cienega Del Gabian Rancho, San Benito County, near the line of Monterey County.

Approximate Analysis.

Water	18.40
Volatile combustible matter	31.15
Fixed carbon	30.00
Ash	20.45
	100.00

1959. Coal, Black Diamond Mine, Mount Diablo, Contra Costa County.
2334. Coal, Santa Clara Coal Mine, twenty miles east of Santa Ana, Los Angeles County.

Analysis.

Water	7.87
Volatile hydrocarbons	29.93
Fixed carbons	49.53
Ash	12.67
	100.00

2378. Coal, Cajon Pass, San Bernardino County.

Analysis.

Water	9.67
Volatile hydrocarbons	27.67
Fixed carbon	46.53
Ash	16.13
	100.00

2533. Coal, Tejon Pass, Kern County.

Analysis.

Water	10.47
Volatile combustible matter	34.60
Fixed carbon	44.86
Ash	10.07
	100.00

2910. Coal, Panoche Pass, Fresno County.

Analysis.

Water	13.73
Volatile hydrocarbons	31.73
Fixed carbon	31.54
Ash	23.00
	100.00

4235. Coal, Monterey County, township twenty-two south, range thirteen east, Mt. Diablo meridian.
367. Coal, near Ione, Amador County.
982. Ionite, found in spots and streaks through coal, Spinks Coal Mine, Lincoln, Placer County.
2093. Ionite, Ione Valley, Amador County.
4808. Ionite, Clipper Coal Mines, near Lincoln, Placer County.
2094. Coke, made from ionite. No. 2093.
5421. Semi-Lignite, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
5422. Lignite, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
305. Lignite, Boney Mine, Vallecitos, Calaveras County.
1267. Lignite, Mendocino County.
1334. Lignite, Carmelo Mine, Monterey County.
2102. Lignite, Ione Valley, Amador County.
2445. Lignite, San Pablo Creek, Contra Costa County.
2379. Lignite, Telegraph Hill, San Francisco.

Analysis.

Water	1.30
Carbon	16.50
Ash	82.20
	100.00

2513. Lignite, near Bieber, Lassen County.

Analysis.

Water	20.40
Volatile hydrocarbons	11.40
Fixed carbon	9.87
Ash	58.33
	100.00

4096. Lignite, near Lexington, Santa Clara County. Analysis: Volatile combustible matter, 29.5; fixed carbon, 47.0; water, 16.5; ash, 7.0; total, 100.0.

4809. Lignite, Clipper Coal Mines, near Lincoln, Placer County. This material has not yet received the study it deserves. It very much resembles ionite which has been analyzed, and, while it has the appearance of being a very inferior lignite, it serves many useful purposes as a fuel, and is consumed in large quantities in the neighborhood.

5187. Lignite, brown coal, Willits, Mendocino County. A caking and coking coal, resembling the Carbon Hill coal. Analysis: Fixed carbon, 41.75; ash, 39.25; volatile combustible matter, and water, 19.00; total, 100.

4116. Petroleum, crude, near Spanishtown, San Mateo County.

4275. Petroleum, crude, Monterey County.

4276. Petroleum, crude, San Luis Obispo County.

5641. Petroleum, crude oil, green oil, specific gravity .795, from a well on Tunitas Creek, San Mateo County, section twenty-five, township six south, range five west. In April, 1884, several barrels per day were being pumped.

5642. Petroleum, crude oil, specific gravity .830, from Pico Cañon, near Newhall, Los Angeles County. This sample was drawn from the end of the main pipe line at the refinery at Newhall, and is the oil which is being sent by the railroad, both north and south, in large quantities.

5643. Petroleum, refined (coal oil), specific gravity .797, refined at Newhall, Los Angeles County, from crude oil (No. 5642).

5608. Sand impregnated with asphalt, and sand separated from it, Coast Range, seven miles northwest of Santa Cruz.

Sand	80.2
Asphalt	19.8
	100.0

The sand angular of milky transparent quartz. This mineral has been distilled for the oil it contains, but which could not compete with eastern oil; it is used, also, for pavements, without preparation. Paving blocks of fine texture, solid and resisting the heat of the sun, are now made of this material by simple pressure, as patent bricks are made, with no addition except a sprinkling of dry sand in the molds.

BORAX.

This mineral is largely produced in California; a full description and history may be found in the third annual report of this office. The total yield of the State to April 30, 1884, was 23,112,286 pounds. The San Bernardino Borax Company made a special exhibit of refined California borax, and William T. Coleman showed some magnificent crystallized Nevada borax refined in Oakland. A large pile of borax from each of these exhibits was placed on each side of the entrance to the California headquarters, and specimens given as souvenirs to visitors. In this manner several hundred pounds were distributed. The following borax minerals from the State Museum were exhibited:

1200. Borax, crude or tincal, Slate Range, San Bernardino County.

1806. Borate of lime, ulexite, Borax Lake, near Grapevine Cañon, Kern County.

1817. Borax, crude material, from the borax deposits, San Bernardino County.

3379. Borax, refined, San Bernardino County.

4668. Borax, crude, Eagle Borax Mining Company, Death Valley, Inyo County.

4669. Borax, refined (see No. 4668), Eagle Borax Company, Death Valley, Inyo County.

4796. Borax pulverized and refined, the production of the San Bernardino Borax Mining Company. Analysis by Edward Booth: biborate of sodium, 52.68; water, 46.25; total, 98.93.

4956. Borate of lime, ulexite, variety technically called "sheet cotton," containing free boracic acid, Death Valley, Inyo County.

4957. Borax, made from ulexite (borate of lime), decomposed by carbonate of soda.

5219. Boracic acid, manufactured from borate of lime, from Desert Springs, Kern County. (See Third Annual Report of State Mineralogist, folio 29.) Manufactured and presented by the Boracic Acid Manufacturing Company.

5283. Borax, refined by the Harmony Borax Company, in Alameda County.
5286. Borax, refined, manufactured by the San Bernardino Borax Mining Company.
5291. Borate of lime, ulexite, Desert Springs Lake, Kern County. Used by Boracic Acid Manufacturing Company.
5292. Borate of lime, sheet cotton, Desert Springs Lake, Kern County.
5293. Boracic acid, 99.8 per cent. Made by the Boracic Acid Manufacturing Company.
5297. Borate of lime, crude, cotton balls, from which boracic acid is made (see No. 5219), from Desert Springs Lake, Kern County. Described folios 29 and 81, Part II, Third Annual Report of the State Mineralogist. Presented by the Boracic Acid Manufacturing Compauy.
5298. Borate of lime, crude, variety known as "sheet cotton," described folio 83, Part II, Third Annual Report of the State Mineralogist, from Desert Springs, Kern County. Presented by the Boracic Acid Manufacturing Company.

MANGANESE.

Ores of manganese are abundant in the State. They are used in glass making, in chemical operations, for bleaching, and in the extraction of gold from sulphurets, and in the Bessemer process of making soft iron and steel. When wanted they will be found in sufficient quantities to satisfy all reasonable requirements.

The following manganese ores and minerals were shown:

467. Manganese ore, Hunter's Valley, Mariposa County.
918. Manganese ore, Tuolumne County.
1170. Manganese ore, near Angel's Camp, Calaveras County.
2337. Pyrolusite (binoxide of manganese), Santa Rosa, Sonoma County.
2375. Pyrolusite (binoxide of manganese), near Tomales, Marin County.
3413. Pyrolusite, found in copper shale, Sweetland Creek Mine, Nevada County.
3657. Pyrolusite and rhodonite, section fourteen, township one north, range ten east, Mount Diablo meridian, two miles south of Summersville, Tuolumne County.
3728. Pyrolusite and rhodonite, near Colton, San Bernardino County.
3772. Pyrolusite, three miles from Cloverdale, Sonoma County,
4088. Manganese ore, impure, containing rhodonite (silicate of manganese) and pyrolusite (binoxide of manganese), from a large deposit two miles north of Sonoma, Tuolumne County, at an elevation of 200 feet above the surrounding country. Course of vein, east and west. The vein is nine feet wide, ten feet below the surface; granite on the north side, slate on the south. It can be traced for a mile. Discovered in 1857 by Henry S. Macomber.
4124. Pyrolusite (binoxide of manganese), Knopp's Ranch, near Columbia, Tuolumne County. Found on the surface in bowlders, from the size of grapes to one hundred pounds in weight.
4337. Pyrolusite, impure, St. Helena Mountain, Napa County.
4900. Pyrolusite, Alameda County.
4965. Pyrolusite (binoxide of manganese), Hahn's Ranch, twelve miles south of the Guadalupe Quicksilver Mine, Santa Clara County.
5053. Pyrolusite, impure, three miles from Railroad Flat, Calaveras County.
5107. Pyrolusite, of excellent quality, Sonoma County.

TIN.

Tin ores have been found at one locality only, in the Temescal Tin Mines, San Bernardino County. As yet there has been no yield, nor have the mines been extensively worked or properly prospected. There is some reason to hope that this metal may yet be found in paying quantities at the locality mentioned.

CEMENT.

Hydraulic cement has been found in the State and has been somewhat manufactured. Some artificial cements and stones have likewise been made, but the business has never gained large proportions. The splendid sidewalks that are now being extensively laid in San Francisco are made generally with imported cement. The statement that pozzuolana had been found in the State was entirely without foundation, although among the numerous volcanic rocks of the State that very valuable cement is likely to be found.

The following specimens were exhibited:

182. Cement, Benicia.
183. Cement, Niles, Alameda County.
2035. Cement rock, Washington Corners, Alameda County.

Analysis.

Silica	.05
Sesquioxide of iron	.16
Carbonate of magnesia	.65
Carbonate of lime	99.14
	100.00

2113. Cement, California Portland; works at Santa Cruz, Portland Cement Company.
2114. Cement, California Portland, in its crude state, before being ground, Portland Cement Company.
2115. Artificial stone, manufactured by Portland Cement Company.
3586. Cement nodules, Glenbrook, Lake County, found in a bluish clay covering an area of ten acres.

ANTIMONY.

Traces of this mineral, generally associated with ores of mercury, are found in numerous localities in the State. The metal has been produced in small quantity, but scarcely with profit to those who have engaged in mining it. The outlook, however, is good for more extensive production. The following specimens exhibited represent the principal known localities in the State. The following antimony minerals were shown:

5770. Stibnite, section thirty, township eleven south, range seven east, Alta Antimony Mine, San Benito County. (See Nos. 450, 690, 702, 4099.)
5939. Stibnite, in magnificent crystals, Alta Antimony Mine, section thirty, township eleven south, range seven east, San Benito County. Mine described on folio 374, Fourth Annual Report of State Mineralogist. See also No. 4099.
2804. Stibnite (sulphuret of antimony), near Gilroy, Santa Clara County.
450. Stibnite, Hollister, San Benito County.
690. Antimony ore, Hollister, San Benito County.
702. Antimony ore, Hollister, San Benito County.
4354. Antimony ore, stibnite, said to contain gold, near Kernville, Kern County.
937. Sulphide of antimony, Kern County.
4643. Stibnite, seven miles from Los Angeles, Los Angeles County.
4099. Stibnite (sulphide of antimony) McLeod (?), San Benito County.
1631. Stibnite (sulphide of antimony), Mammoth Mine, Mineral King District, Tulare County.
1642. Stibnite (sulphuret of antimony, see No. 1631), Mineral King District, Tulare County.
4904. Stibnite, sulphide of antimony, Panamint Valley, Inyo County. This deposit has long been known, and may be found located on Atlas Sheet No. 65 D., Wheeler's geographical surveys and explorations west of the one hundredth meridian.
4092. Stibnite (sulphide of antimony), San Emidio Antimony Mine, township ten north, range twenty-one west, San Bernardino meridian, Kern County. For description see "Pacific Railroad Reports," vol. V, folio 291.

ROCKS AND BUILDING STONES.

Building materials are very abundant in California, and can be obtained in nearly every part of the State. Attention has lately been drawn to the importance of replacing the temporary wooden buildings with those of a more substantial nature. At Mokelumne Hill, in Calaveras County, and at St. Helena, in Napa County, a tufaceous volcanic or solfataric stone has been utilized with great satisfaction, and some beautiful as well as durable buildings erected. This stone is so soft when first quarried that it may be fashioned with axes, and with time it hardens. It is likely to prove as useful and valuable as it is extensive. Granite is somewhat also used for foundations, and a few buildings of that material have been erected. It is now well known that beautiful marbles abound in the State, but they are not as yet generally utilized. Brick of the very best quality are

cheaply produced, and many fine buildings are being erected of this excellent and most durable material. It is the intention of this office to make a special collection and study of the rocks and building stones of the State, and to publish the results. The following catalogue of the rocks and building materials exhibited at the Exposition has been arranged alphabetically, for want of time to make a better classification:

5300. Agalmatolite (?), somewhat resembling the Chinese figure stone, and similar to a rock from San Luis Obispo County (No. 4060). This beautiful ornamental stone is found two miles west of Greenwood, El Dorado County, in a vein from six inches to a foot in thickness.

4227. Basaltic fragment from a bowlder of lava, plains between Oroville and Pence, Butte County. Concave on one side, convex on the other, showing how angular fragments of rocks weather into rounded bowlders, without water-washing.

1734. Black alta (argillaceous schist), New Almaden Quicksilver Mine, Santa Clara County.

3365. Block of basalt. Used for street pavement. Mt. Pisgah quarries, one mile south of Petaluma, Sonoma County.

3441. Borings from James Phelan's well. O'Farrell Street, San Francisco: A, 185 feet deep; B, 192; C, 200; D, 225; E, 240; F, 245; G, 251; H, 260; I, 265.

5774. Borings, from bottom of well No. 2, Petrolia, Los Angeles County.

5775. Borings, from a depth of 500 feet, Snow's oil well, Petrolia, Los Angeles County.

5778. Borings, representing section of an oil well, Turenitas Creek, San Mateo County: A, 90 feet; B, 130 feet; C, 140 feet; D, 150 feet; E, 160 feet; F, 170 feet; G, 200 feet; H, 220 feet; I, 234 feet; J, 256 feet; K, 280 feet; L, 290 feet; M, 300 feet; N, 320 feet; O, 356 feet; P, 360 feet; Q, 364 feet; R, 382 feet; S, 386 feet; T, 390 feet; U, 398 feet; V, 403 feet; W, 431 feet; X, 460 feet; Y, 478 feet; Z, 484 feet; aa, 501 feet; bb, 508 feet; cc, 515 to 586 feet.

3732. Breccia, hills back of Oakland, Contra Costa County.

4150. Bowlder of fine grained diorite or basalt, Folsom, Sacramento County. Strongly resembling serpentine externally.

4341. Breccia of red jasper in white quartz, Glenbrook, Lake County.

3014. Building stone, Mr. Wheat's house, Double Springs, Calaveras County.

348. Calcite, Inyo County.

656. Calcite, Point San Pedro, San Mateo County, eighteen miles south of San Francisco.

1224. Calcite, from the Old Chapman Quicksilver Mine, Santa Clara County.

1741. Calcite, New Almaden Quicksilver Mine, Santa Clara County.

1862. Calcite, Clipper Gap Lime Quarry, section thirty, township thirteen north, range nine east, Mount Diablo meridian, Placer County.

2002. Calcite (stalagmite), quarry of Davis & Cowell, Santa Cruz County.

2003. Calcite (white), quarry of Davis & Cowell, Santa Cruz County.

2004. Calcite (blue crystalline), quarry of Davis & Cowell, Santa Cruz County.

2005. Calcite (marble), quarry of Davis & Cowell, Santa Cruz County.

2162. Calcite (black), Amador County, near Volcano.

2163. Calcite, Amador County, near Volcano.

2384. Calcite, Inyo County.

2775. Calcite, Mad Ox Mine, near Whisky Creek, Shasta County.

3420. Calcite, Polar Star Mine, Dutch Flat, Placer County.

4147. Calcite (limestone), Santa Cruz County.

5009. Calcite, bed of the Klamath River, Yreka, Siskiyou County.

3692. Calcite, blue, San Diego County.

4069. Calcite, pink, Small Hill Mine, Santa Catalina Island.

2192. Chrysolite with calcite, near Independence, Inyo County.

5089. Cement rock (impure carbonate of lime), hill west of road to Weston's Cañon, San Gregorio Pass, San Bernardino County.

69. Clay, Ione Valley, Amador County.

167. Clay, Mount Diablo, Contra Costa County.

186. Clay, Ione, Amador County.

241. Clay, Comanche Mine, Mono County.

248. Clay slate, Mount Hamilton, Santa Clara County.

419. Clay, Ione Valley, Amador County.

473. Clay slate, bored by worms, Mono Lake, Mono County.

563. Clay, ferruginous, Ione Valley, Amador County.

980. Clay, surface, Spinks Coal Mine, Lincoln, Placer County.

984. Clay, underlying coal, Spinks Coal Mine, Lincoln, Placer County.

985. Clay, lying between two sand streaks, Spinks Coal Mine, Lincoln, Placer County.

986. Clay, lying between the coal streaks above the main ledge, Spinks Coal Mine, Lincoln, Placer County.

1332. Clay, Duncan Mills, Marin County.

1504. Clay, yellow, mistaken for native sulphur, Redington Mine, Lake County.

1722. Clay wall, Orient Mine, Bodie District, Mono County.

1773. Clay, ferruginous, Clipper Gap, Placer County.

1823. Clay, indurated, corner of Filbert and Leavenworth Streets, San Francisco.

Analysis.

Silica	56.51
Alumina	21.33
Sesquioxide of iron	12.31
Lime	3.53
Water	6.30
Magnesia	Trace.
	99.98

1831. Clay, Dutch Creek, twenty miles northeast of Placerville, El Dorado County.
1944. Clay, near Lincoln, Placer County, called by the potters, blue plastic clay.

Analysis.

Silica	44.82
Alumina	34.54
Combined water	8.37
Hygroscopic water	1.27
Carbonate of lime	3.00
Magnesia	.96
Soda	4.74
Sesquioxide of iron	1.86
Loss	.44
	100.00

1945. Clay, near Lincoln, Placer County, called by the potters white non-plastic clay.

Analysis.

Silica	41.80
Alumina	38.78
Combined water	6.00
Hygroscopic water	1.62
Carbonate of lime	2.64
Magnesia	1.02
Soda	3.46
Sesquioxide of iron	2.12
Loss	2.56
	100.00

2096. Clay, from well at Hotel Del Monte, Monterey, forty-five feet.
2097. Clay, from well at Hotel Del Monte, Monterey, ninety-six feet.
2098. Clay, from well at Hotel Del Monte, Monterey, two hundred and sixteen feet.
2117. Clay, black, stained with oxide of manganese, west or hanging wall of Bodie mines, found throughout the district.
2118. Clay, found opposite Independence, Owen's Valley, Inyo County.
2120. Clay, blue slip, three-hundred-foot level, Dudley Mine, Bodie, Mono County.
2123. Clay, near Jackson, Amador County.
2368. Clay, two miles north of Santa Rosa, Sonoma County.
2732. Clay, with pyrite, three miles north of Ione City, Amador County.
2907. Clay, said to occur in large quantities in Mendocino County, near Point Arena.
3023. Clay, Bodie, Mono County.
3393. Clay, "pipe clay," Malakoff Mine, North Bloomfield.
4100. Clay, five hundred and ten feet deep, basin of Clear Lake, five miles west of Soda Bay, Lake County.
4101. Clay, five hundred and twenty-five feet deep, basin of Clear Lake, five miles west of Soda Bay, Lake County.
4105. Clay, fire, Shasta County.
4106. Clay, "blue clay" (so called), three hundred feet from the Dudley Mine, Bodie, Mono County.
4221. Clay, No. 4220. Burned in a potter's kiln, by Gladding, McBean & Co., which shows it to be well fitted for the manufacture of fine pottery.
4272. Clay (specially suited for the manufacture of fire brick), Michigan Bar, Sacramento County.
4500. Clay, from an artesian well ninety-eight feet deep, near Willow Street, San Antonio, Alameda County.
4646. Clay (kaolin), Amador County, near Sacramento; N. Clark & Sons, agents, Pacific and Sacramento Potteries.
4803. Clay, six foot stratum, forty feet deep, Clipper Coal Mines, near Lincoln, Placer County. (See Nos. 979 to 987.)
4806. Clay, found below the coal beds, seventy-five feet below the surface, Clipper Coal Mines, near Lincoln, Placer County.
4807. Clay, washed, from the sand stratum, thirty feet below the surface, Clipper Coal Mines, near Lincoln, Placer County.
4916. Clay (Nos. 4220 and 4421), baked in a common sewer pipe kiln, by Gladding & Mc-

Bean, who say if it was properly washed and otherwise prepared it would be equal to the best kaolin; Nevada City, Nevada County.

5090. Clay, overlying cement rock (No. 5089), San Gregorio Pass, San Bernardino County.

5791. Clay, "pipe clay," North Bloomfield Mine, Nevada County.

5429. Concretions, Gold Gravel Hydraulic Mine, La Porte, Plumas County.

311. Conglomerate, McCloud River, Shasta County.

2100. Conglomerate, Point Lobos, seven miles southwest of Monterey.

2106. Conglomerate, Pebble Beach, Pescadero San Mateo County.

4065. Conglomerate bowlder, Pescadero, San Mateo County.

5423. Conglomerate (coarse), cemented by iron pyrites, Gold Gravel Hydraulic Mine, La Porte, Plumas County.

5424. Conglomerate (fine grained), cemented by iron pyrite, Gold Gravel Hydraulic Mine, La Porte, Plumas County.

5425. Conglomerate (coarse grained), cemented by oxide of iron, Gold Gravel Hydraulic Mine, La Porte, Plumas County.

1348. Conglomerate, Bay of San Francisco.

4244. Deposit from Paso Diablo Springs, Inyo County.

2079. Diabase (Feldspar, Pyroxene, and Chlorite), with section for the microscope, North Pacific Railroad, near Saucelito, Marin County.

35. Diatomaceous earth, Santa Monica.

240. Diatomaceous earth, Los Angeles.

175. Diatomaceous earth, Ione Valley, Amador County.

436. Diatomaceous earth, San Gregorio, San Mateo County.

444. Diatomaceous earth, San Joaquin Valley, seventy miles from Stockton, near San Carlos Ranch, Pacheco Pass.

557. Diatomaceous earth, Staples Ranch, San Joaquin County.

654. Diatomaceous earth, ten miles north of Petaluma, Sonoma County.

791. Diatomaceous earth, with fossils, Santa Barbara.

793. Diatomaceous earth, with fossils, Santa Barbara.

830. Diatomaceous earth, Monterey.

976. Diatomaceous earth, with fossils, Santa Barbara County.

1184. Diatomaceous earth, near Comanche, Calaveras County.

1185. Diatomaceous earth, Port Harford, San Luis Obispo County.

1246. Diatomaceous earth, Lost Spring Ranch, Lake County.

1217. Diatomaceous earth, Santa Barbara.

1248. Diatomaceous earth, Santa Monica, Los Angeles County.

1283. Diatomaceous earth, Lost Spring Ranch, Lake County.

1284. Diatomaceous earth, Santa Catalina Island.

1331. Diatomaceous earth, Dutch Flat, Placer county.

1362. Diatomaceous earth, near Comanche, Calaveras County.

2459. Diatomaceous earth (?), near Pinole Station, Contra Costa County.

1448. Diatomaceous earth, Port Harford, San Luis Obispo County.

1742. Diatomaceous earth, fourteen miles below San Pedro, Los Angeles County.

1832. Diatomaceous earth, eighteen miles southeast of Santa Rosa, Sonoma County. Lies between strata of Aragonite and Gray Sandstone.

2444. Diatomaceous earth, Ventura County.

2511. Diatomaceous earth, very rich in diatoms, Graham Cañon, five miles south of Santa Rosa, Sonoma County.

2741. Diatomaceous earth, white outcrop on the Salinas road, Jacks' Ranch, near Monterey, Monterey County.

3437. Diatomaceous earth, Cayetano Ranch, Santa Clara County.

3775. Diatomaceous earth (called chalk), Doolan Mine, near Santa Rosa, Sonoma County.

5411. Diatomaceous earth, Bitterwater Ranch, San Benito County.

1216. Diatomite (?), Santa Barbara County. This is found in the strata of diatomaceous earth, and is supposed to have been silicified by soluble silica from beds above. The name was suggested by Dr. W. W. Finch, who discovered it.

1940. Diorite, wall rock of the Clipper Gap Iron Mine, Placer County.

1941. Diorite, near the bridge, section fifteen, township eighteen north, range thirteen east, Mount Diablo meridian, Placer County.

1943. Diorite, township thirteen north, range eight east, Mount Diablo meridian, Placer County.

2042. Diorite, iron mines near Clipper Gap, section twenty-four, township thirteen north, range eight east, Placer County.

2052. Diorite, wall of furnace building, Clipper Gap Iron Mines, Placer County.

2282. Diorite, fine grained (with section), Mineral Hill District, Mono County. This specimen contains more hornblende than No. 2283, which is from the same locality. It contains also considerable finely divided magnetite.

2283. Diorite, fine grained (with section), containing less hornblende than No. 2282, which is from the same locality, and in which magnetite is replaced by pyrites, Mineral Hill, Mono County.

3016. Diorite, with section, cut by Frank Atwood, croppings near Cave City, Calaveras County.

242. Dolerite, east wall, Comanche Mine, Mono County.

2175. Dolomite (carbonate of lime and magnesia), Modoc Mine, Inyo County.

2215. Dolomite, Guadalupe Quicksilver Mine, Santa Clara County.
2238. Dolomite (resembling fossil coral), Morro, San Luis Obispo County.
2524. Dolomite, nodule, spur of hills north of Morro Bay, San Luis Obispo County, six miles from the ocean, and at an elevation of two hundred to three hundred feet. These nodules are found near the surface, and vary in size from a few inches to a foot or more in diameter; many of them have cavities lined with crystals.
2820. Dolomite, Deep Spring Valley, Inyo County.
4483. Dolomite (white), Amargosa Wash, San Bernardino County. This mineral is very common in the Inyo Mountains.
5051. Dolomite, Inyo County.
5088. Dolomite (white), Tujunga Cañon, seven miles from San Fernando, San Gabriel Mountains, Los Angeles County; valuable for building and manufacturing purposes.
5369. Dolomite (impure), found near the State University, Berkeley, Contra Costa County; mistaken for pozzuolana.
5935. Earth (adobe), lying above the "brea" (asphaltum), Brea ranch, near Los Angeles.
5546. Feldspathic rock, which seems to be decomposing into kaolin (No. 5544), near Daggett Station, San Bernardino County.
4958. Fossiliferous rock, near Soledad, San Diego County.
2776. Garnet rock, Calpella, Mendocino County. From a large cropping.
4259. Glaucophane rock, wall rock of the Collier Mine, six miles northeast from Murphy's, Calaveras County.
1431. Gneiss, brought to San Francisco on river schooners and used for street pavements.
5086. Gneiss, said to be found in San Francisco in place, but this needs confirmation.
23. Coarse granite, near Sacramento.
214. Granite, Newcastle, Placer County.
216. Granite, Folsom, Sacramento County.
217. Granite, Rocklin, Placer County.
326. Granite, polished, Rocklin, Placer County.
459. Granite, Yosemite Valley, Mariposa County.
1126. Granite, Mariposa Mine, Mariposa County.
1867. Granite, Rocklin, Placer County.
1882. Granite, Crystal Lake, Summit Valley, Nevada County.
1884. Granite (micaceous), near Penryn, Placer County.

GRAVELS, HYDRAULIC.

1675. Mechanic analysis of:

Portion A, coarse non-magnetic	56.6
Portion B, fine non-magnetic	18.4
Portion C, magnetic	25.0
	100.0

A—Contains garnets, sulphides of iron, various dark colored grains, and a striated mineral which, under the microscope, resembles selenite.
B—Is principally quartz sand. There are some amorphous particles of a red color, and the mineral resembling selenite. There are no zircons.
C—Is almost entirely magnetite.
1210. Gravel, San Pablo, Contra Costa County.
5941. Gravel, distinct from the sandstone; used in macadamizing streets, Los Angeles.
548. Hornblende rock, Santa Barbara Mountains.
2263. Hornblende rock, Healdsburg, Sonoma County.
2913. Hornblende rock, Folsom, Sacramento County.
4266. Hornblende rock, Gold Run, Placer County.
1320. Hydromagnesite, Market Street Cut, near Guerrero Street, San Francisco.
4219. Impressions of leaves in the so called "white lava," (4471), two miles from San Andreas, Calaveras County. This specimen seems to prove two facts: First, the formation must have been soft, to admit of the leaves being imbedded; second, the lava could not have been in an igneous state, or the leaves would have been burned, and could not possibly have left their impression as seen in the specimen. The formation must have been volcanic mud, which preceded the igneous flow of true lava with which it is capped.
2443. Incrustation, mud volcanoes, Colorado Desert, San Diego County.

Analysis.

Water	2.35
Chloride of sodium	1.26
Sesquioxide of iron	2.16
Sulphate of lime	1.79
Carbonate of lime	78.10
Carbonate of magnesia	2.84
Silica, clay, etc.	9.97
	98.47

94. Jasper, Potrero, San Francisco.
551. Jasper, Murphy's, Calaveras County.
559. Jasper, near St. Helena, Napa County.

569. Jasper, near St. Helena, Napa County.
902. Jasper, Tuolumne County.
1203. Jasper, Saucelito, Marin County.
1720. Jasper, six varieties, near Saucelito, Marin County.
2409. Jasper, showing glacial polish (?), Market Street Cut, San Francisco.
3416. Jasper, Bald Prairie, Placer County.
3749. Jasper, Little Shasta, Shasta Valley, fourteen miles east of Yreka, Siskiyou County.
5043. Jasper, red, creek bed near Windsor, Sonoma County.
5162. Jasper, red pebbles, beach at Monterey.
5431. Jasper, red pebbles, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
5596. Jasper, red, polished, three specimens, hills end of Rannall Street, San Francisco. This jasper is probably metamorphic, silicious, and ferruginous mud, and is found in great abundance on the hills. The polish of the specimens shows that it is unfit for ornamental purposes, which would otherwise be inferred from its appearance in the rough state.
5597. Jasper, red (see 5596), showing a naturally polished surface, first thought to be caused by a glacier, but closer inspection leads to the opinion that it is caused by movement of the mass when in a soft state (slickensides). The large blocks upon which it is found seem to be "erratics;" some of the faces bear a striking resemblance to those polished by glaciers. Found on the hills back of San Francisco. Drifting sand may possibly have caused the polish.
5598. Jasper, angular fragments, found in the railroad cut, Southern Pacific Railroad, just beyond Rannall Street, San Francisco, in a large deposit without stratification, and resembling the morraine of a glacier. It is difficult to account for this formation by any other theory.
5599. Jasper, breccia of red, in white quartz, hills back of San Francisco.
5769. Jasper, red, Hathaway Gold Mine (croppings), Calaveras County.
268. Kaolin, Kern County.
1095. Kaolin, Tuolumne County.
4220. Kaolin, seven miles southeast of the Town of Grass Valley, Nevada County, section three, township fifteen north, range nine east; deposit, six feet thick; surveyed area, about ten acres; actual area, unknown. For analysis see report of Professor Hilgard, in the annual report of the State University for 1881.
5284. Kaolin, sections four and five, township sixteen north, range eight east, Nevada County.
5285. Kaolin, baked in potter's oven, by Gladding & McBean, and pronounced by them to be a good white burning clay, or kaolin, from the deposit No. 5284, Nevada County.
5544. Kaolin, crude, found near Daggett Station, San Bernardino County. Mr. Daggett believes it to be the result of the decomposition of a feldspathic rock (No. 5546), which occurs in great abundance. He thinks there is doubt as to its being found in quantity.
5545. Kaolin (No. 5544), cleaned by washing, found near Daggett Station, San Bernardino County.
5593. Kaolin, mechanical analysis of, from San Bernardino County, near Daggett Station (see No. 5544); portion purified by washing, 85.45 per cent.
5594. Kaolin, mechanical analysis of (No. 5544); coarser impurities, 7.21 per cent.
5595. Kaolin, mechanical analysis of (No. 5544); finer impurities, 7.34 per cent.
198. Lava, Mendocino County.
219. Lava, Napa County.
383. Lava, compact, near St. Helena, Napa County.
1694. Lava, basaltic, near Calistoga, Napa County.
1875. Lava, red, Butte Mountain, near Jackson, Amador County.
2371. Lava, near Santa Rosa, Sonoma County.
3018. Lava, trachytic (?) which caps isolated hills between Milton and San Andreas, Calaveras County.
3649. Lava, brecciated, found in immense cliffs, Little Shasta River, Shasta County.
4228. Lava, basaltic, showing a scale, which is due to oxidation of iron to limonite, near Doon's Mill, Butte County.
4471. Lava, white (so called), indurated volcanic ash, near Murphy's, Calaveras County.
4673. Lava, which exists in immense quantities on the borders of Mono Lake, Mono County. Owens River cuts through this formation in a deep cañon. It is easily decomposed, and supposed to yield the soda salts so abundant in that region. It crops out also at Adobe Meadows, in Mono County. It is well worthy of a critical examination.
4406. Lava, white, so called, probably indurated volcanic ash, Southern Pacific Railroad, Los Angeles County.
4972. Lava, and pumice, Alviso, Santa Clara County. The Guadalupe River winds through a chain of volcanic vents. They rise but a few feet above the valley.
5084. Lava, cellular, with zeolite, Soledad Cañon, Los Angeles County.
5109. Lava, cellular, Captain Jack's Cave, Modoc Lava Beds, Modoc County.
165. Limestone, calcite, Santa Cruz.
565. Limestone, San Bernardino County.
1680. Limestone, tufaceous (thinolite?), Lassen County, section thirty, township thirty north, range fourteen west.
1863. Limestone (marble), Clipper Gap Lime Quarry, section thirty, township thirteen north, range nine east, Mount Diablo meridian, Placer County.

1866. Limestone (marble), Cave Valley, near Auburn, Placer County.
1910. Limestone (hydraulic?) found at the residence of Captain J. M. McDonald, San Francisco.
1981. Limestone (fossiliferous). Almaden Consolidated Quicksilver Mining Company, southwest quarter section thirty-four, township twenty-six south, range ten east, San Luis Obispo County; elevation fifteen hundred feet.
1982. Limestone, Bridgeport, Mono County.
1983. Limestone, Tres Pinos, San Benito County, fifteen miles east of the town.
2171. Limestone, Modoc Mine, Inyo County.
2428. Limestone, weathered (possibly glacier grooving), Cave City, Calaveras County.
3440. Limestone, arenaceous, found in the bed of the river, near Yreka, Siskiyou County.
4376. Limestone or marble, blue, with veins of white, Pence, Butte County. It is soluble in hydrochloric acid with effervescence, leaving a small hepatic residue—when struck with a hammer it emits a fetid odor—anthraconite—burns to a pure white lime, which slakes perfectly. This stone is well adapted for building purposes, as a useful and ornamental stone. Valuable also for manufacturing purposes.
5019. Limestone (water-worn bowlder), Posa Creek, foothills of the Sierra Nevada, Kern County.
5083. Limestone, near Auburn, Placer County.
5349. Limestone, silicious, with what seems to be graphite or molybdenite in small scales, Kern County.
5412. Limestone (marble), Bitterwater Ranch, San Benito County.
2789. Lithographic stone (?), Kern County, exact locality not given.
2322. Magnesite (carbonate of magnesia), Tulare County.
5159. Magnesite, Damascus, Placer County. Large quantities of this mineral at the locality.
59. Marble (white), fifteen miles from Monterey.
141. Marble, near Angel's Camp, Calaveras County.
266. Marble, Bear Creek, three miles from Colfax, Nevada County.
267. Marble, Abby's Ferry, Tuolumne County.
710. Marble, Giallo Antico, Tehachapi, Kern County.
904. Marble (white), Tuolumne County.
1939. Marble (white), section fifteen, township thirteen north, range eight east, Mount Diablo meridian, Placer County. This marble has been used in San Francisco for the generation of carbonic acid in the manufacture of mineral waters. It is used also as a flux in iron smelting.

Analysis.

Silica	.15
Sesquioxide of iron	.35
Lime	55.72
Carbonic acid	43.78
	100.00

2011. Marble, white, Tehachapi, Kern County.
2799. Marble, black, near Central Pacific Railroad, two miles above Colfax, at the lower end of the high trestle, Placer County.
2807. Marble, half a mile from the railroad depot, Auburn, Placer County.
3387. Marble, from the Cave at Cave City, Calaveras County.
3604. Marble, water-worn, bed of the Tuolumne River, Tuolumne County.
4894. Marble, white, nine miles north of Ione, Amador County.
5344. Marble, red, a beautiful ornamental stone, bearing a good polish, Amador County.
5543. Marble, fine white, slightly bluish green, suitable for building stone and lime, Inyo County, near C. and C. R. R.
5341. Metamorphic slate, which accompanies the quartz vein, Soulsby Mine, Tuolumne County. (See No. 5329.)
5342. Metamorphic slate, with quartz attached, Soulsby Mine, Tuolumne County. (See No. 5329).
798. Mica schist, Gold Lake, Plumas County.
1092. Mica schist, Ivawatt District, San Bernardino County.
4236. Mica schist, Berkeley Hills, Alameda County.
316. Obsidian, banded, Clear Lake, Lake County.
376. Obsidian, Glass Mountain, near St. Helena, Napa County.
481. Obsidian, Sulphur Bank Quicksilver Mine No. 2, Lake County.
483. Obsidian, White Ranch, nine miles west of Lower Lake, Lake County.
482. Obsidian and sulphur, Sulphur Bank Quicksilver Mine No. 2, Lake County.
484. Obsidian, sulphur, and cinnabar, Sulphur Bank Quicksilver Mine No. 2, Lake County.
485. Obsidian, Occident Mine, Lower Lake, Lake County.
992. Obsidian, Rosebaugh Ranch, Sulphur Bank, Lake County.
993. Obsidian and cinnabar, Rosebaugh Ranch, Sulphur Bank, Lake County.
1197. Obsidian, near Lower Lake, Lake County.
1207. Obsidian, near Kelseyville, Lake County.
1258. Obsidian with iron pyrites, Lake County.
1390. Obsidian, volcanic glass, Mono Lake, Mono County.

1890. Obsidian, Sonoma County.
4674. Obsidian, variegated, near the southern end of Goose Lake, Modoc County.
4908. Obsidian, variegated, near McBride's Ranch, Mono County.
1858. Orbicular, diorite (napoleonite), near Rattlesnake Bar, El Dorado County.
4060. Ornamental stone, allied to agalmatolite (pagodite), etc. A hydroscilicate of alumina, magnesia, lime, iron, etc., San Luis Obispo County.
1549. Pacific magic polish, Las Tablas Creek, San Luis Obispo County. West half of the northwest quarter of section twenty-two, township twenty-six south, range ten east, Mt. Diablo base and meridian. It is not diatomaceous earth. Under the microscope the particles are seen to be regular in size and quite amorphous. The deposit is one thousand three hundred feet above the sea level, lies horizontally, and is about six feet in thickness. An analysis is being made by the Agricultural Bureau at Washington.
2370. Painted rock (so called), twelve miles from Santa Rosa, Sonoma County.
1222. Pebbles, from the beach at Crescent City, Del Norte County.
1903. Pebbles, from the shores of Mono Lake, Mono County.
2271. Pebbles, Sebastopol, Sonoma County.
2847. Pebbles, twelve samples, from the beach at Pescadero, San Mateo County.
4906. Pebbles, found beneath the coal, Clipper Coal Mine, Lincoln, Placer County.
5161. Pebbles of porphyry, beach at Monterey, Monterey County.
5432. Pebbles of metamorphic rock, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
5771. Pebble sand, in which coil oil is found, Snow's Well, near Petrolia, Los Angeles County.
5983. Pebbles of jasper, from Pebble Beach, Pescadero, San Mateo County.
5984. Pebbles of lydian stone or basanite, Pebble Beach, Pescadero, San Mateo County.
5985. Pebbles of porphyry, Pebble Beach, Pescadero, San Mateo County.
5986. Pebbles of chalcedony, Pebble Beach, Pescadero, San Mateo County.
5987. Pebbles of sedimentary rock, Pebble Beach, Pescadero, San Mateo County.
5988. Pebbles of fine sedimentary rock, Pebble Beach, Pescadero, San Mateo County.
1116. Pitch stone, Paso Robles, San Luis Obispo County.
1091. Porphyry, foot wall Standard Mine, Bodie District, Mono County.
1542. Porphyry (?), argentiferous, Bodie Mine, Bodie Mining District, Mono County.
1789. Porphyritic diorite, Clipper Gap, Placer County.
2887. Porphyry, red, eight or nine miles from Mesquite Station, San Diego County.
3402. Porphyry bedrock, Malakoff Mine, North Bloomfield, Nevada County.
3418. Porphyry bowlder, Polar Star Mine, Dutch Flat, Placer County.
4057. Porphyry (probably diorite), Placer County. Said to be found in large quantities. A very beautiful building and ornamental stone, equal to the finest porphyries of Egypt and Europe.
4112. Porphyry, seventy-five feet thick, Bodie Mine, Mono County.
1762. Pumice stone, near Mammoth City, Mono County.
959. Pumice stone, near Dos Palmos, San Diego County.
1645. Pumice stone or volcanic ash, found six hundred yards southerly from the easterly part of Lake Merced, San Francisco County. Extensively used as pulverized pumice stone.
3698. Small pebbles of pumice stone, Colorado Desert, five miles west of Volcano Station, Southern Pacific Railroad, San Diego County.
443. Pumice, Mono Lake, Mono County.
247. Quartzite, southern part of Los Angeles County.
397. Quartzite, Geysers, Sonoma County.
471. Quartz hacked, Pine Tree Mine, Mariposa County.
955. Quartz pebbles, near Big Tank, Colorado Desert, San Diego County.
1117. Quartz breccia, Paso Robles, San Luis Obispo County.
1446. Quartz breccia, Hirschman's Hydraulic Mines, Nevada County, from Paris Exposition collection.
1528. Quartz and chalcedony pebbles (selected), Pescadero Beach, San Mateo County.
2748. Quartz diorite, west wall of the Champion Mine, Providence Belt, Nevada County.
2422. Quartz, Succedo Shaft, five hundred feet below the surface, Mariposa Tunnel, mother vein, Mariposa Estate, Mariposa County.
2781. Quartzite (wall rock), Mad Ox Mine, near Whisky Creek, Shasta County. (See No. 2274.)
3022. Quartz with remarkable impressions of crystals, of a mineral probably orthoclase, from Volcano, Amador County. This rare specimen should be carefully studied.
3398. Quartzite, Malakoff Mine, North Bloomfield, Nevada County.
3706. Quartz, rose, Hope Valley, Alpine County.
3707. Quartz, rose, Yokhe (?) Valley, Tulare County.
3708. Quartz, rose, Plumas County.
5430. Quartz pebbles, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
1088. Quartzose, trachytic, diorite altered, probably from near some large ore body Bodie, Mono County.
1088. Quartzose, trachytic, diorite altered, the feldspar mostly sanidin. Hanging wall Standard Mine, Bodie District, Mono County.
4794. Rock soap, San Benito County.
3389. Bedrock, Malakoff Mine, North Bloomfield, Nevada County.
3390. Bedrock, Malakoff Mine, North Bloomfield, Nevada County.

3395. Bedrock, Malakoff Mine, North Bloomfield, Nevada County.
3399. Bedrock, Cherokee, Nevada County.
3400. Bedrock at flume, Milton Mine, Nevada County.
3397. Bedrock, Gold Run, Placer County.
3401. Bedrock, American Mine, near North San Juan, Nevada County.
3408. Bedrock of Manzanita Mine, Nevada City, Nevada County.
3407. Bedrock at flume, Milton Mine, Nevada County.
3410. Bedrock at end of flume (gneiss), Milton Mine, Nevada County.
3414. Bedrock, Malakoff Mine. North Bloomfield, Nevada County.
3391. Bowlder, Polar Star Mine, Dutch Flat, Placer County.
3409. Bowlder, Malakoff Mine, North Bloomfield, Nevada County.
3419. Bowlder, Polar Star Mine, Dutch Flat, Placer County.
2280. Burnt rock, Guadalupe Quicksilver Mine, Santa Clara County.
1750. Cap rock, overlying the depression between Bodie Bluffs and Silver Hill, Bodie District, Mono County. Five hundred feet thick on Silver Hill.
1262. Casing, from north side Uncle Sam Quicksilver Mine, near Clear Lake, Lake County.
3404. Chalcedonic bowlder, Polar Star Mine, Dutch Flat, Placer County.
1749. Country rock, Mineral King District, Tulare County.
3582. Country rock with section for the microscope (trachyte), Rocky Bar Mine, Grass Valley, Nevada County.
3583. Country rock, with section for the microscope (trachyte), Rocky Bar Mine, Grass Valley, Nevada County.
2143. Country rock, east (not determined), Euchre Bar Mine, Placer County.
1477. Foot wall, New Almaden Quicksilver Mine, Santa Clara County. From Paris Exposition collection.
2876. Foot wall, Conrad Mine, Duncan Hill, near Auburn, Placer County.
5082. Foot wall of the Great Eastern Quicksilver Mine, Sonoma County, 220-foot level (see No. 5081).
2356. Formerly the highest point of Mount Diablo, Contra Costa County.
440. Glacier polished rock, Yosemite Valley, Mariposa County.
1723. Green rock, met with before reaching the so called foot wall, new Almaden Quicksilver Mine, Santa Clara County.
2144. Hanging wall (east), Euchre Bar Mine, Placer County.
2416. Hanging wall, Gold Run Mine, Webber Creek, El Dorado County.
2877. Hanging wall of the Conrad Mine, Duncan Hill, near Auburn, Placer County.
3359. Inclosing rock, with microscopic section, Pioneer Mine, Marin County. (See No. 3358.)
708. Piece of Blossom Rock, Bay of San Francisco.
1543. "Red float," found, as a rule, over the surface of Bodie Bluff, Mono County, and which imparts a characteristic red color to the whole belt.
1828. Rock formation, Sam. Simms Mine, in which roscoelite was first discovered, Granite Creek, El Dorado County.
1829. Rock formation. Sam. Simms Mine, in which roscoelite was first found. When the thin quartz veins cross this formation gold is no longer found. Granite Creek, El Dorado County.
1830. Rock formation, in which roscoelite is found, near Mr. Kimble's house, El Dorado County.
5601. Rock formation, found near Campo Seco, Calaveras County, with section for microscope. Analysis by W. D. Johnston:

Silica	72.00
Alumina	26.20
Lime	.51
Iron, sesquioxide	.60

The analysis and section are from the small piece: the large one is softer.

2746. Rock resembling halleflinta, Fruit Vale, Alameda County.
4340. Rock resembling halleflinta, Spanish Ranch, Plumas County.
15. Rock from serpentine belt, San Francisco County.
516. Rock specimen, Mariposa Tunnel, Mariposa County, two thousand-foot wall rim.
564. Rock specimen, near St. Helena, Napa County.
567. Rock specimen, Ione Valley, Amador County.
963. Rock specimen, Big Tank, Colorado Desert, San Diego County.
1587. Rock specimen, Frenchman's Road, Bear Valley, Mariposa County.
1713. Rock specimen, face of tunnel, Iron Mountain Mine, seven miles from Shasta.
1883. Rock specimen, four miles south of Crystal Lake, Nevada County.
1907. Rock specimens (two with pyrites), tunnel of the Contra Costa Road and Tunnel Company, one hundred and eighty-five feet from the face.
1942. Rock specimen, township thirteen north, range eight east, Mount Diablo meridian, Placer County.
1961. Rock specimen, San Francisco.
1962. Rock specimen, ocean beach, ten miles south of San Francisco.
1963. Rock specimen, road from Oakland to Berkeley, Contra Costa County.
1964. Rock specimen, Calistoga, Napa County.
1965. Rock specimen, Mark West, near Santa Rosa, Sonoma County.

1968. Rock specimen, fifteen miles from Monterey, Monterey County.
1970. Rock specimen, Butte Creek.
1971. Rock specimen, Pine Flat, Sonoma County.
1972. Rock specimen, Lower Lake, Lake County.
1974. Rock specimen, McCloud River, Shasta County, five samples.
1984. Rock specimen (jaspery), Monitor, Alpine County.
1985. Rock specimen (wall rock), Bonanza Queen Mine, Fresno County.
1986. Rock specimen, Kearsarge District, Inyo County.
1987. Rock specimen, Kearsarge District, Inyo County.
1988. Rock specimen, Kearsarge District, Inyo County.
1989. Rock specimen, Kearsarge District, Inyo County.
1990. Rock specimen, Kearsarge District, Inyo County.
1991. Rock specimen, Kearsarge District, Inyo County.
1992. Rock specimen, Kearsarge District, Inyo County.
1993. Rock specimen, Kearsarge District, Inyo County.
1994. Rock specimen, Kearsarge District, Inyo County.
1995. Rock specimen, Kearsarge District, Inyo County.
2186. Rock specimen, Deep Springs District, Inyo County.
2187. Rock specimen, found in large masses on the eastern slope of the White Mountains, Inyo County.
2415. Rock specimen, foot-wall at sixty feet, Gold Run Mine, Webber Creek, El Dorado County.
2733. Rock specimen, Soledad Cañon, Los Angeles County.
2808. Rock specimen, road between Auburn and the iron furnace, Placer County.
3405. Rock specimen, bridge at Yuba River, below Blue Tent, Nevada County.
3669. Rock specimen, locality, Inyo Range, two thousand feet above Owen's Valley, Inyo County, of peculiar interest, consisting of alternate layers of quartzite and limestone. On the weathered surface the limestone has been cut away, probably by the action of drifting sand, while the quartzite remains clear and sharp. The specimen is an interesting study, the question suggesting itself how the two minerals were deposited so evenly and with such alternate regularity. When found the strata were vertical.
3734. Rock specimen, Los Angeles County, seven miles from Alpine station.
4024. Rock specimen (so called soap rock), San Buenaventura, Ventura County.
5340. Rock specimen, country rock, granite, or quartz diorite (?), Soulsby Mine, Tuolumne County. (See No. 5329.)
5413. Rock specimen (jaspery metamorphic), Coal Mine, San Benito County, township nineteen south, range eleven east.
5414. Rock specimen (metamorphic), Coal Mine, San Benito County, township nineteen south, range eleven east.
5416. Rock specimen (conglomerate), Coal Mine, San Benito Connty, township nineteen south, range eleven east.
5419. Rock specimen (not determined), Coal Mine, San Benito County, township nineteen south, range eleven east.
5420. Rock specimen (not determined), Coal Mine, San Benito County, township nineteen south, range eleven east.
4212. Rock specimen (undetermined), Eureka, Humboldt County.
4242. Rock specimen (marked "iron ore"), Chimney Rock Mine, township four south, range ten west, Mount Diablo meridian. This is certainly not an iron ore, although it seems to contain specular iron in small quantities.
4267. Rock specimen (not determined), near Colfax, Placer County.
4676. Rock specimen, fragment detached in cutting the base of the State line monument, near McBride's Ranch, Mono County.
4679. Rock specimen, detached in cutting the shaft of the State line monument between California and Nevada, near McBride's Ranch, Mono County. (See No. 4676.)
5287. Rock specimen, hanging wall, Nevada City Mine, 600-foot level (see No. 4853); the mine is situated one mile and a half from Nevada City, Nevada County.
5288. Rock specimen, foot wall of the Nevada City Mine, one and a half miles from Nevada City, Nevada County. (See No. 5287.)
442. Rock, summit Mount Dana, Tuolumne County (?).
3396. Rock used in paving the flumes, Milton Hydraulic Mine, Nevada County.
5027. Rock with barite, Copper World Mine, Clark's Mining District, San Bernardino County.
1548. Dividing rock separating the "white cap" from the "brown yellow," South Belvidere Mine, six hundred and thirty feet deep, Bodie District, Mono County.
633. Vein matter with pyrites, Keystone Mine, Amador County.
2139. Vein matter, hanging wall, Euchre Bar Mine, Placer County.
2140. Vein matter, foot wall, Euchre Bar Mine, Placer County.
2141. Vein matter, near the hanging wall, Euchre Bar mine, Placer County.
4463. Vein matter, Santa Anita Mine, Poorman's Creek, Nevada County.
432. Wall rock of 431, two and a half miles from Carmelo Bay, Monterey County.
632. Wall rock and vein matter, Keystone Mine, Amador County, five hundred and fifty-seven-foot level, east wall.
1478. Wall rock, horse, Idaho Mine, Grass Valley, Nevada County. From Paris Exposition collection.

1479. Wall rock, Maryland Mine, Grass Valley, Nevada County. From Paris Exposition collection.
1725. Wall rock, in or near the foot-wall, New Almaden Quicksilver Mine, Santa Clara County.
1726. Wall rock, in or near the foot-wall, New Almaden Quicksilver Mine, Santa Clara County.
1846. Wall rock of quartz vein (No. 1845), Jenny Lind, Calaveras County.
2028. Wall rocks, New Toledo Mine (see No. 2025), Tuolumne County.
2188. Wall rock of Indiana Mine, near Swansea, Inyo County. (See No. 2180.)
2333. Wall rock of serpentine, called "green rock," Guadalupe Quicksilver Mine, Santa Clara County.
3779. Wall rock (blue dyke), Jupiter Mine, six hundred-foot level, face of west drift, Bodie District, Mono County.
3780. Wall rock, Syndicate Mine, Bodie District, Mono County.
4090. Wall, or country rock, San Emidio Antimony Mine, Kern County.
4462. Wall rock, slate, Santa Anita Mine, near the Washington Mine, Poorman's Creek, Nevada County.
2142. West country rock (serpentine), Euchre Bar Mine, Placer County.
1548. Sample of the dividing rock separating the "white cap" from the "brown yellow," South Belvidere Mine, six hundred and thirty feet deep, Bodie District, Mono County.
1547. Sample, broken from one of the chalcedonic bowlders, strewn over the surface. beginning on the Syndicate Claim and crossing the Tioga, Standard, Bodie, and Mono Claims, Bodie, Mono County. These bowlders are built up in strata, which disintegrate into concave layers.
2272. Sand rock with chalcedony, ten miles west of Havilah, Kern County.
453. Sandstone, near San José, Santa Clara County.
914. Sandstone, eighteen feet thick, Tuolumne County.
1205. Sandstone formation, Saucelito, Marin County.
1486. Sandstone, Glenn Mills, San Mateo County.
2166. Sandstone, eight miles west of Napa City, Napa County.
4215. Sandstone, suitable for building stone, Eureka, Humboldt County.
4258. Sandstone (?) (stained red), Santa Margarita Ranch, San Diego County, near San Luis Rey.
4480. Sandstone, Glenn Mills, San Mateo County.
5081. Sandstone, west side of Great Eastern Quicksilver Mine, Sonoma County, supposed to be the footwall (see No. 2744).
5417. Sandstone (coarse grained), Coal Mine, San Benito County, township nineteen south, range eleven east.
5418. Sandstone (fine grained), Coal Mine, San Benito County, township nineteen south, range eleven east.
4142. Sandstone nodule (pear-shaped), San Lorenzo River, near Santa Cruz, Santa Cruz County.
5080. Sandstone, sedimentary, Seal Rock, off Point St. George, northwest boundary of California.
810. Sandstone, fossiliferous, near Shasta.
4451. Sandstone, variegated, near Buchanan Copper Mine, Fresno County.
1518. Sandstone, feldspathic (?), sedimentary rock, composed of feldspar, quartz mica, and hornblende, Telegraph Hill, San Francisco.
2110. Sandstone, weathered, Pescadero, San Mateo County.
658. Scoria, Point San Pedro, San Mateo County, eighteen miles south of San Francisco.
833. Saponite, rock soap, Ventura County.
4239. Schist with garnets, mouth of Russian River, Sonoma County.
5346. Schist, with impressions of fossil plants, found in the lignite near Vacaville, Solano County.
5801. Sedimentary deposit, Chalk Bluffs, near surface, containing impressions of fossil leaves.
5787. Sedimentary matter, North Bloomfield Mine, Nevada County.
4473. Sedimentary deposit, found in digging a well, at a depth of seventy-five feet, near Roseville Station, Placer County.
178. Sedimentary rock, San Francisco.
222. Sedimentary rock, Cliff House, San Francisco.
1681. Sedimentary rock, Oil Creek, San Luis Obispo County, found in slabs from two to eight inches thick, and from one to three feet wide.
2376. Sedimentary deposit resembling diatomaceous earth, twelve miles east of Santa Rosa, Sonoma County.
488. Serpentine, Bear Valley, Mariposa County.
449. Serpentine, Key's Tunnel, California Mine, Yolo County.
513. Serpentine, three hundred yards northeast of Pine Tree Mine, Bear Valley, Mariposa County.
8. Serpentine, transformation from gabbro, and microscopic section. Peninsula of San Francisco.
544. Serpentine, Fort Point, San Francisco.
554. Serpentine, Fort Point, San Francisco.
580. Serpentine, Yuba County.

1273. Serpentine, Market and Guerrero Streets, San Francisco.
1539. Serpentine (polished), center of Lone Mountain Cemetery, San Francisco.
1540. Serpentine (five varieties), Lone Mountain Cemetery, San Francisco.
1686. Serpentine, Market Street Cut, San Francisco.
1724. Schistose serpentine, met with before reaching the so called foot wall, New Almaden Quicksilver Mine, Santa Clara County.
2778. Serpentine (polished), Kelseyville, Lake County.
3415. Serpentine (?), Bald Prairie, Placer County.
4146. Serpentine, Monterey, Monterey County.
3736. Shale (with lignite), near San Bernardino, San Bernardino County.
4910. Shell rock, Sandstone Bluff, township one north, and on the Humboldt meridian, Humboldt County.
2189. Silicious breccia (buhr mill stone), Little Butte, section thirteen, township thirteen south, range thirty-five east, Mount Diablo meridian.
911. Slate and granite, Bodie District, Mono County.
237. Slate and pyrites, Mariposa Tunnel, two thousand six hundred and twenty-foot point, Mariposa County.
3015. Slate, which crops out over a large extent of country between San Andreas and Cave City, Calaveras County; strike nearly west northwest, dip nearly vertical.
4959. Slate, near Red Hill, Butte County.
4079. Slate, near Emigrant Gap, Placer County.
5993. Slate, roofing, from El Dorado County.
577. Slickensides, Yuba County.
5192. Slickens, typical specimen of, taken from the American River, near Sacramento. For description and analysis, see Second Report of the State Mineralogist, folio 99.
5782. Slickens, finely divided, American River.
5785. Slickens, Manzanita Mine, Nevada City.
5786. Slickens, North Bloomfield Mine, Nevada County.
5789. Slickens, North Bloomfield Mine, Nevada County.
5779. Slickens, samples of dry, American River, Twelfth Street Bridge, Sacramento.
5780. Slickens, American River, Sacramento.
5797. Slickens, Marysville, Yuba County.
5798. Slickens, Polar Star Mine, Dutch Flat, Placer County.
3751. Soil, Frink's Spring, Colorado Desert, San Diego County.
3753. Soil, average sample, near Volcano Station, Southern Pacific Railroad, Colorado Desert, San Diego County.
3754. Soil, five miles east of Volcano Station, Southern Pacific Railroad, Colorado Desert, San Diego County.
3755. Soil, two miles east of Frink's Spring, Colorado Desert, San Diego County.
5772. Soil, Tehachapi Pass, Los Angeles County.
5773. Soil, from the cut made by the railroad at Newhall, Los Angeles County.
5784. Soil, American River bottom, Sacramento; used to fill up gardens.
172. Steatite, soapstone, Placer County.
578. Steatite, Yuba County.
908. Steatite, eight feet thick, Tuolumne County.
1443. Steatite, fourteen miles below San Pedro, Los Angeles County, on the coast.
1459. Steatite wall rock, Maryland Mine, Grass Valley, Nevada County. From Paris Exposition collection.
1654. Steatite, Fresno County.
1685. Steatite, two miles northeast of Jackson, Amador County.
1864. Steatite, Stockbridge Soapstone Works, township fifteen north, range nine east, Mount Diablo meridian, near Colfax, Placer County.
2050. Steatite, Taylorville, Paper Mill Creek, Marin County.
2270. Steatite, mountain, Kern County.
2366. Steatite, Tule River, Tulare County.
3644. Steatite, cut in the form of bricks and of the same size, to be used as substitute for fire-brick, Lewis, Mariposa County.
3724. Steatite (much resembling French chalk), Pine Flat, Sonoma County.
4472. Steatite, near Murphy's, Calaveras County.
2057. Stratified formation, old lime kiln, near Clipper Gap, Placer County.
659. Syenite, Point San Pedro, San Mateo County, eighteen miles south of San Francisco.
4016. Talcose rock, wall rock of the Idaho Mine, Grass Valley, Nevada County.
2276. Talc in quartz, Yosemite Gold Mine, Mariposa County.
920. Talcose slate, Tuolumne County.
1298. Talcose slate, gold bearing, El Dorado County.
568. Trachyte, near St. Helena, Napa County.
1310. Tripolite, Santa Barbara.
42. Tufa, Kern County.
2125. Tufa, Sulphur Springs, Mono County.
5427. Tufa (?), very interesting formation, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
5994. Volcanic breccia, used as a building stone in Susanville. It is said to resist the action of fire, as shown during a recent conflagration in that town. Section five, town-

ship twenty-nine north, range thirteen east, eight and one half miles from Susanville, Lassen County.

1391. Volcanic conglomerate, Mono Lake, Mono County.

1644. Volcanic rock, Kelsey Valley, Lake County, taken from a well ten feet deep. It is several feet in thickness. Sinking the well was discontinued owing to the emanation of large quantities of carbonic acid gas.

2512. Volcanic ash allied to pumice stone, Calaveras County, eighteen miles from Lodi.

4750. Volcanic tufa (so called white lava), a similar rock is used in Europe in building ovens for bread baking (See No. 4751), found near Etna Springs, Napa County.

4499. Volcanic ash, Chalk Bluffs, Nevada County.

4893. Volcanic ash (?), Ione Valley, Amador County.

5542. Volcanic ash, tufa or lava, Mono County, near Carson and Colorado Railroad.

The following is a list of minerals of lesser value which have been produced in the State in considerable quantities, with figures showing the estimated production as far as known: Salt, annual yield bay salt, 40,000 tons. Sulphur, annual yield, 1,881,697 pounds. Lime, annual yield, 2,757,742 barrels. Gypsum and chrome iron are largely produced, but no reliable figures can be given.

The State is rich also in other economic minerals which will eventually be worked, and which can be found when wanted. The following are worthy of special notice: Barite, bismuth ores, clays, diamonds, feldspar, kaolin, magnesian minerals, mineral and alkaline waters, ochre, platinum, quartz sands, zinc ores, etc.

SUNDRIES EXHIBITED BUT NOT CLASSIFIED.

4030. Cream of tartar (containing ninety-seven per cent of bitartrate of potash), manufactured from California argols (see Nos. 4145–4210) Pacific Cream Tartar Works, San Francisco.

4145. Crude argols, Krug's Vineyard, St. Helena, Napa County.

4210. Crude argols, taken from the interior of California wine casks (see No. 4145).

3610. Fibrous bituminous artificial stone block for street pavements, manufactured by the Cosmopolitan Paving and Asphaltum Company.

1366. Floating bricks, made from diatomaceous earth, with a small quantity of clay. Useful for the building of light masonry, filling in of walls, and between floors of wooden buildings, to render them to a certain extent fire-proof. These bricks are made wholly of California materials. Similar ones were shown in the Italian Department of the Paris Exposition of 1878.

2967. Fire brick, made of California clay.

5201. Fire bricks, from California fire clay at Lincoln, Placer County. The clay from which they are made underlies ionite (see No. 982).

4786. Great seal of the State of California (in gold). Exhibited at the Paris Exposition of 1878.

1754. Ingot of antimony, from California ores.

4753. Nickel ore, said to be found in San Benito County.

1901. Ore containing nickel, Metallic Mine, near Cisco, Placer County.

1902. Ore containing nickel, Chief Mine, near Cisco, Placer County.

2410. Ore (galena, blende, and stibnite), from Dunlap Mine, head of Santiago Cañon, Los Angeles County.

3638. Rock soap, Ventura County, Ventura Rock Soap Company.

931. Rock soap (marine), Ventura County.

932. Rock soap (toilet), Ventura County.

933. Rock soap (laundry), Ventura County.

934. Rock soap (tooth powder), Ventura County.

935. Patent compressed paving tile or slab, asphaltum base with cement top.

3752. Salt, mud volcanoes, at Volcano Station, Southern Pacific Railroad, Colorado Desert, San Diego County.

4273. Salt, Inyo Range, forty miles northeast of Independence, and near to Benton, Mono County.

4282. Salt (island salt), Union Pacific Salt Company, Alameda County.

4449. Salt, Owens River Valley, Inyo County, between Bishop Creek and Big Pine; said to occur in large quantities.

5189. Salt (No. 1), manufactured in 1882, at Mount Eden, Alameda County. The details of the manufacture of bay salt are described in the Second Report of the State Mineralogist, folio 217.

5115. Salt, mud volcanoes, San Diego County.

5309. Solar salt, from the great deposit in the bed of an ancient lake in the Colorado Desert, San Diego County, now being worked by the New Liverpool Salt Company.

71. Solar salt, ten miles from Panamint, Inyo County.

1868. Slag, from lime quarry at Alabaster Cave, Placer County.

2264. Section of a pipe nearly filled with carbonate of lime, Frink's Spring, Colorado Desert, San Diego County. This pipe lay in the ground for only two years. The mineral is aragonite, containing magnesia, sulphate of lime, oxide of iron, and silica, as impurities.

SUNDRY SPECIAL EXHIBITS.

Large ornamental garden vase and specimens of pottery, sewer pipes, terra cotta, etc., by Gladding, McBean & Co. of San Francisco. After the Exposition these specimens were sent to the Louisville Exposition, from which they will be returned and placed in the State Museum.

Hand crusher and apparatus, by John Taylor & Co. of San Francisco. This apparatus is fully described in Mr. Attwood's paper under the head of *gold*.

Samples of petroleum paint, by the Paraffine Paint Company of San Francisco.

The following State maps were also exhibited:

Amador County.
Bodie County.
Butte County.
California and Nevada.
Calaveras and Tuolumne Counties.
Humboldt County.
Monterey County.
Marin County.
Merced County.
Nevada County.
Sutter County.
Sonoma County.
San Luis Obispo County.
San Joaquin County.
Solano County.
San Francisco County.
San Francisco City and County.
San Francisco Around the Bay.
Tuolumne County.
Yolo County.

Notes of a Flying Trip of Seventeen Days through the Gold Mines of Georgia and other Mining Localities in the South.

Being much interested in the exhibit of minerals made by the Southern States at the Exposition, and especially in the representation made by Georgia, North Carolina, and Alabama, I determined to visit some of their most important mining districts. With this view I left New Orleans by the Queen and Crescent, or Northeastern Railroad, April 21, 1885. The road crosses a portion of Lake Pontchartrain on twenty-two miles of trestle-work. On the opposite side of the lake the train passed extensive turpentine, tar, and pitch works, which I had an opportunity to observe, and gained practical information as to the mode of producing these valuable articles of commerce. This may be of importance to California, as it is known that we have extensive forests of pine, which could yield a vast quantity of turpentine, if required. During the civil war, when the Southern supply was cut off, our State, to a considerable extent, met the demand for that valuable product. During that period extensive works were put up and successfully conducted near Dogtown, Butte County, an account of which has been given in the second annual report of this office, folio 209.

When we crossed Pearl River I noticed that while the stream was sluggish it carried a quantity of yellow mud, resembling the hydraulic slickens of California. In the pineries the soil is not fertile. The sands are usually yellow, or of a red or pink shade, and contain a water-washed gravel resembling that of the hydraulic mines of California, particularly in the vicinity of Dutch Flat, a notable placer mining district of our State.

The town of Meridian, in Mississippi, is a thriving, busy, enterprising place, with substantial buildings, and is an important railroad center. Its elevation above sea level is about two hundred feet.

Birmingham, in Alabama, is a new town which has grown within a few years from a simple railroad crossing to a well built, enterprising, manufacturing town of great importance to the South. This advance has resulted from the discovery of extensive beds of coal and iron, lying side by side, in the vicinity, and the presence of a railroad system, which, by offering facilities for cheap transportation, makes it possible to work the mines to advantage. I remained in Birmingham two days, which I spent in visiting the mines and furnaces, and studying the conditions by which cast iron can be made more cheaply than it can be produced in Pennsylvania or elsewhere in the United States. The results of my observations will be found elsewhere under the head of "Alabama." Thomas G. Davies, General Superintendent of the Sloss Iron Furnace, furnished me with much valuable information.

The next point of interest reached was Chattanooga, Tennessee. At Chattanooga Mr. Andrews, of Andrews & Barton, lawyers, took me in a carriage to places of note and interest: to Lookout Mountain, the National Cemetery, and through the beautiful suburban streets and drives. From an eminence I was shown the town and river, and the battle grounds, which will be for many years celebrated in United States history. I visited the Citico Iron Furnaces, where Mr. Edward Doud, the Manager, conducted me over the works. These works are described under the head of "Tennessee." I left on the twenty-fifth of April, by rail, arriving at Marietta, Georgia, after a few hours' journey. Marietta is a delightful little town, but is neither enterprising nor progressive. As yet it does not seem to have caught the infection which has made Atlanta and Gainesville what they are.

At 9 A. M. on the twenty-sixth, I left Marietta by the Marietta and North Georgia Narrow Gauge Road. The country in this region is hilly and the climate delightful. The soil, generally, along the line of the road, is poor, but in some spots is exceptionally good. The county seems to be as well adapted for the cultivation of grapes and other fruit as any part of California. There are many small but comfortable homesteads on the road, and the prevailing appearance is one of comfort and quiet prosperity.

After leaving Marietta the altitude is decreased, and remains about one hundred feet below Marietta, until beyond Mabel. For some distance the course of the road is along the River Etowah, a narrow, sluggish, muddy, winding stream. The surrounding country is exceedingly picturesque, with occasional broad landscapes of great beauty.

Near Tate there is a marble quarry, two and a half miles from the road. This marble is mentioned elsewhere. Tate is the shipping point, from which there is a branch track laid to the quarries. The works where the marble is wrought are at Marietta. The product finds a market chiefly in the north and west, Chicago, Cincinnati, St. Louis, and other cities employing considerable quantities. It is rather attractive in appearance, being white veined with blue. There is a mountain range here called the Long Swamp Mountains.

Jasper and Talking Rock are passed before reaching Ellijay, the present termination of the road. Ellijay is a beautiful town, the county seat of Gilmer County. The people do not seem to realize what a beautiful spot they live in. With a little more enterprise it might be made one of the most desirable residence spots and attractive resorts in the State.

On the twenty-seventh I left Ellijay by private conveyance, accompanied by Mr. W. S. Albright of Chattanooga, who has valuable mining interests in Georgia. The road we took follows the grade of the railway for some distance, and the direction is almost due northeast. It crosses a spur of

the Blue Ridge at an altitude of about nineteen hundred feet. Six miles from Ellijay we passed old workings of placer gold mines, which were practically abandoned on the discovery of gold in California. The ancient pits and bowlder piles were almost an exact picture of many abandoned diggings in California. Some persons have lately recommenced operations and have taken out some gold. The country looks like California, and it would seem as if the grounds could be worked to advantage, if water, dump, and permission of the agriculturists, could be obtained. Having no interest in solving these questions, I made no special inquiries, nor did I leave the road for the purpose of investigation. To an old Californian the piles of sluice boxes and mining ditches with muddy running water, had a homelike aspect. On the road we passed White Path Chalybeate Springs, at which beautiful and romantic locality there is a hotel which is a noted Summer resort. Passing Cherry Log at an elevation of fifteen hundred feet, we reached a deposit of limonite iron ore, which had the appearance of being worked. I was so interested in the fact that it was possible to work an iron mine under such conditions, that I stopped and made an investigation. I found no regular deposit, but an open cut into a red hill. The cut was not more than a hundred feet long nor over ten to fifteen feet deep. I found in the red earth, however, nodules of limonite, but they were not very abundant. Near a sluice box at a small running stream near by, I found where the ore was being worked, and the nodules separated and laid up in a small pile.

From this circumstance I concluded that it was gold that was being sought, and that the iron ore was not considered, for I could not understand how it could be of any value so far from coal. As the men had gone to dinner I could not make any inquiries, but, entering the carriage again, we soon met Mr. John Buchanan, the owner of the iron mines, and from him gained the following information: The nodules of limonite are gathered and hauled to Hemptown, near Morgantown, where there is a rude forge, consisting of a trip hammer driven by water, and a furnace. The fuel used is charcoal. The ore is heated and hammered, returned to the furnace for a second heating, and again placed beneath the hammer. This process is continued until soft, malleable, and tough iron in bars is obtained, which are used by the local blacksmiths for making horseshoes and other common iron work. The capacity of the works is only twenty-three tons of soft iron in a year. The manufactured iron is sold at three cents a pound. This makes the value of the entire output of the furnace $1,380 per year. I asked Mr. Buchanan how much he received per ton for his ore, upon which he informed me that he hauled it to Hemptown and received at the forge, twelve and one half pounds of soft iron bars in return for each ton of ore delivered. This, at three cents per pound, netted him thirty-seven and a half cents per ton.

The circumstance of meeting Mr. Buchanan, and the interesting facts gleaned from him, led me to consider that we in California might derive a valuable lesson from this primitive iron mining in Georgia. If our people in California would consider how much better their condition is than that of the people I have just been describing, they would be less disposed to complain of what is considered "hard times." It is pleasing to consider that there is no necessity for our people to resort to such primitive plans to furnish themselves with iron, or other industrial necessities, but it would be better for us if we could be more economical, and display more enterprise in utilizing the products of the State, instead of importing what we could produce at home. This method of making iron directly from the ore is called the Catalan process, because it has been practiced in Cata-

lonia, in Spain, from the most remote period known to history down to the present time. It is undoubtedly the simplest method of making iron, but it cannot be employed on a large scale, because it is a very crude process, wasting both ore and fuel. When, however, the ore is found in abundant quantities, and both fuel and labor are cheap and plentiful, as in Georgia, it is a good process, and can be employed to advantage. The method may be briefly stated. The ore is heated in an inexpensive furnace of peculiar construction, by means of charcoal placed under the influence of a powerful blast, which is generally obtained by falling water in a tube which becomes entangled with a quantity of air which rises into a closed chamber, while the water flows away. The compressed air is then conveyed in pipes to the furnace. When the first charge of ore falls down, in a semi-fused condition, more is added, until a mass or bloom of spongy iron is obtained, which is placed under the trip-hammer and welded into an ingot of compact and very superior iron. The oxygen of the ore forms carbonic oxide with a portion of the charcoal, by which the metallic iron is set free.

Continuing on our way, at the crossing of the Oconee River, we passed a large pile of pure white talc by the roadside, and were informed that much of this mineral was taken out and shipped elsewhere.

After living in the sultry atmosphere of New Orleans the weather here was particularly enjoyable. If made specially to order it could not have been more delightful. Our next halt was at Morganton, the county seat of Fannin County, situated at an altitude of 1,800 feet. Here I learned more of the iron manufacture at Hemptown, and the names of the proprietors—Messrs. Johnson, Wilson & Son. Crossing the Young Cane Mountain at an elevation of 2,245 feet, we arrived at Blairsville, a beautifully situated mountain town, having an altitude approximating 1,955 feet. This place occupies a central position in a very interesting and important gold region. In the year 1845, gold was discovered at Coosa, a little hamlet about five miles distant from Blairsville. The mining excitement in those days ran high, and upwards of a thousand miners were on the spot at one time. Of the metal extracted, some $500,000 was coined at the Dahlonega Mint alone. During my stay at Blairsville and vicinity, I was the guest of Judge C. J. Wellborn, and with this genial host began to realize the full meaning of old-time southern hospitality.

On the twenty-ninth of April we left Blairsville on horseback and rode in a northerly direction, toward the Gum Log Mining District. At a church on a hill, six miles distant from Blairsville, we sent the animals back and proceeded on foot, over a beautiful mountain route, to Gum Log Hill, which is described elsewhere under the head of "Georgia." At Old Gum Log we were hospitably entertained by Mr. Gregg.

From this point we went on to Wellborn Hill, a few miles distant, remaining until the first of May, as the guests of Mr. J. Van Brown and family, who did all in their power to make us comfortable, and furnished us with valuable information regarding the surrounding country. The scenery from this point is superb. The view of the distant blue hills of North Carolina equals in picturesque beauty the scenery along the fairest portions of our Coast Range. Being near the line of North Carolina we crossed over one day and visited Brasstown and the neighboring gold mines, returning the same day. This was all I saw of that State. The Marietta and North Georgia Railroad will soon be completed to within ten miles of Gum Log and fifteen miles of Blairsville. A. G. Kinsey, the manager of the road, whom I afterwards met at Atlanta, informed me that in the course of a few months the rails would be laid to Murphy in North Carolina.

On the second of May I left Blairsville in a private carriage furnished

by Judge Wellborn and driven by his brother, Mr. Erastus Wellborn, Mr. Albright who had been with me since leaving Chattanooga, having returned to Wellborn Hill. The day was especially fine, the air cool and bracing, and I found a thick coat comfortable.

Crossing Atkins' Mountain, at an elevation of 2,175 feet, and approaching the Blue Ridge, the climate and scenery so strongly resembled California that I could hardly realize I was in Georgia, and not in my own State. The summit of the Blue Ridge is thirteen and a half miles from Blairsville. In traversing this mountainous district, I could not avoid noticing the numerous opportunities for water power which have never been utilized. The really fertile lands are not cultivated to their full capacity; but I found that the people deliberately chose a life of ease to one of industry, and preferred dispensing with the luxuries of life to the labor of procuring them. As they always have every necessary comfort and are never destitute, I began to think that perhaps their condition was preferable to the worry and toil that we of the North think essential to supply our wants and needs. What impressed me most was the general absence of books and newspapers in the houses I visited; yet I was informed that there was a marked awakening in Georgia on the subject of education and schooling, and that efforts were being made to extend the school term to nine months in the year, instead of three months as heretofore. At Atlanta and at Gainesville I was informed that this had already been effected. With better facilities for education, the people of the mountain region of Georgia—a healthy, vigorous race, who have the clear brains and strong natures of a people bred in high altitudes—will undoubtedly be stimulated to improve their homes and to cultivate their lands to better advantage.

As we neared the Blue Range the road became rougher, and more outcroppings of rock were visible. These rocks were usually gneissoid, with mica schist and shales with small veins of quartz. In passing, I noticed on the surface in several localities the same tabular, granular quartz which is auriferous at Gum Log and at Wellborn Hill. At an elevation of two thousand eight hundred and fifty-five feet in the pass, I perceived a well defined quartz vein, which, if in California, would not long remain without being prospected. It was several feet thick in places, and the quartz looked promising. There are high mountains on each side of the pass, and the summit was found to have an approximate altitude of three thousand one hundred feet. On the other side of the mountains the road descends rapidly southward. Toward Dahlonega the route passed a miners' ditch, crossing the cañons in flumes like those in our State. Ten or twelve miles from Dahlonega I observed good looking float quartz by the roadside. The season on the south side of the mountains is fully two weeks earlier than on the north side. The trees were in full leaf, and the country appeared at its best.

Seven miles from Dahlonega we passed the Garnet Mill, and saw a ten-inch pipe which conveyed water under pressure to the turbine wheel that drove the mill. The building was a pleasing feature of the landscape and bore a marked resemblance to a California quartz mill of the first class.

The very interesting and beautiful town of Dahlonega was named from the Cherokee words Ta-la-ne-ga, meaning yellow metal or yellow money. My barometer here indicated an altitude of fourteen hundred and eighty-five feet, which is probably within fifty feet of the correct figure. The town is situated in the center of a well known gold field, discovered and successfully worked before those of California. The mines lie principally on Findley Hill, a ridge which rises from a hundred and fifty to two

hundred feet above the town. Findley Hill is covered with barren looking float quartz and broken gneissoid rocks. The scenery from the summit is particularly pleasing. The landscape has not the element of sublimity which marks the high mountain regions of the Pacific Coast, but partakes of the restful beauty of foothill and valley. In the distance the purple peaks of the Blue Ridge rise above the thickly wooded green hills of the foreground, while Dahlonega lies in the green lap of the valley. The mines in this vicinity, and the manner of working them, which differs from anything practiced in California, are fully described under the head of "Georgia."

In Dahlonega I had the pleasure of meeting many intelligent gentlemen, who greatly facilitated my efforts to obtain the information of which I was in quest, and to whom I am also indebted for numerous courtesies. Col. William P. Price, a gentleman of prominence in the legal profession, and who has occupied an important political office under the State, is familiar with the mining laws and land divisions of the district. He was the prime mover in the successful effort to have the abandoned United States Mint transferred to the State, as well as in organizing the Georgia Military and Agricultural College. Colonel R. H. Moore, another old resident, gave me much information bearing on the early history of the gold mines. Mr. J. O. Robertson, who formerly lived and mined in Plumas County, California, furnished me with specimens, and accompanied me to the principal mines. John Huff, Superintendent of the Barton and Hand, and Ralston Mines, was in California from 1851 to 1854, at Iowa Hill. His familiarity with the mines of Dahlonega and the processes employed, was of great assistance to me. Mr. C. L. Perrin, Superintendent of the Georgia Consolidation Gold Mining Company and the Ivey and Bast Consolidation Companies, and Mr. J. W. Steuart, Superintendent of the Keystone placer mine, from which he gave me fine specimens, also rendered me valuable service.

I remained in Dahlonega two days, during which I diligently examined the mines and mills within a radius of two miles, with the town as a center. Most of the principal mines of the district lie within this area. A full description of them, and the manner in which they are worked, is given under the proper head.

On Monday, May fourth, I left Dahlonega by stage, and in the evening arrived at Gainesville, which lies about 120 feet below. This is a thriving town, where the people are strongly imbued with the spirit of the New South. A number of fine brick buildings have recently been erected, and a noticeable air of progress distinguishes the place from many of the mountain towns through which I had lately passed. Gainesville is not a mining place, but there are gold mines about three miles southeast of the town. These are the Merck mines, which have gained some celebrity, but whether with reason or not I could not learn, nor could I spend the time to visit them. From Gainesville to Atlanta, a distance of about forty miles, the passage was made by the Atlanta and Richmond Air Line Railroad.

There is something about Atlanta which arouses the surprise of every stranger, a sentiment quickly changed to admiration when he has spent a few hours in the streets of the city. The parks and streets are fine and well kept; the private dwellings elegant, and generally surrounded by ornamental grounds and gardens; the public buildings are stately and imposing; the hotels commodious and well kept, and charges moderate; the newspapers are liberal in their principles and ardent in their advocacy of measures for the advancement of the people, the city, and the State. In many respects the place resembles European cities, and on a lesser scale, is strongly suggestive of the City of Paris, probably on account of its broad

and cleanly streets and the iron bridges which cross the railroads. Prosperity, enterprise, bustle, and thrift are its most striking characteristics. Atlanta is the capital of the State, and was incorporated as a city in 1849. It is a leading railroad center, and has a number of important institutions of learning, a State library, and several other public libraries. It is quite a manufacturing city, and manufactures are encouraged, and are rapidly increasing, so that a large capital is centered there. During the civil war Atlanta was the scene of a desperate struggle; the people suffered every hardship, and a large portion of the city was burned or otherwise destroyed. She has now wholly recovered from the effects of this blow to her prosperity, and entered upon a new era of peace and progress, which is very gratifying to behold. After one day's stay I returned to New Orleans by the Georgia Pacific Railroad, passing Oxford, Birmingham, Meridian, and other important places of local importance, arriving at my destination on the morning of the seventh of May, "California day," in season to take part in the exercises.

I desire to express here my obligations to the Queen and Crescent Railroad and the Marietta and North Georgia Railroad Companies, and to their employés, for favors extended, which materially aided me in my investigations; and I cannot speak too warmly of my appreciation of the unusual courtesy and hospitality extended to me wherever I went.

Altitudes.

These altitudes were taken with a good mountain aneroid barometer, but without any check against atmospheric changes, for which reason they are only approximate, but will serve to show the character of the country passed over. The elevations in capitals are taken from published measurements, and from them my own observations were modified:

BIRMINGHAM, ALABAMA	596	Young Cane Mountain, Georgia	2,245
CHATTANOOGA, TENNESSEE	665	Blairsville, Georgia	1,955
MARIETTA, GEORGIA	1,133	Gum Log, Georgia	1,925
Ballground, Georgia	1,105	Wellborn Hill, Georgia	1,975
Tate, Georgia	1,285	Atkins Mountain, Georgia	2,175
Jasper, Georgia	1,435	Blue Ridge Pass, Georgia	3,095
Ellijay, Georgia	1,285	DAHLONEGA, GEORGIA	1,519
White Path Springs, Georgia	1,485	Columbia Hill, Georgia	1,685
Cherry Log, Georgia	1,565	GAINESVILLE, GEORGIA	1,227
Blue Ridge, or Ellijay Pass, Georgia	1,695	ATLANTA, GEORGIA	1,045
Morgantown, Georgia	1,805		

The first discovery of gold in the Southern States seems to have been in Virginia, near the Rappahannock River. The first published notice appears to be in Jefferson's Notes on Virginia, as mentioned by Whitney (*Metallic Wealth of the United States*, folio 15). A lump was found weighing seventeen pennyweights, equal to .85 ounces. In 1799 a lump of gold was found by a young man named Reed, in Cabarrus County, North Carolina, which is said to have been "as large as a small smoothing iron," rather an indefinite description, but conveying the idea of a large nugget, even from the California standpoint. He kept it in his possession for some years, and then, not knowing or suspecting its value, sold it for a few shillings. Soon after, gold was discovered in Montgomery County, where small washings were conducted and several large nuggets were found in the two counties. One found in Cabarrus County weighed twenty-eight pounds (408.32 ounces), and others from four to sixteen pounds (58.3 to 233.32 ounces). The first workings were very primitive and crude, and the yield was small, with the exception of the large nuggets mentioned. The average yield was sixty cents per day to each individual employed.

No deposit that did not yield one pennyweight (.05 ounces Troy) to the hand was considered worth working. The first workings were confined to the beds of streams. The surface soil was removed and a characteristic clay or gravel deposit washed in a small cradle and finished in a mining pan. In 1825 gold was found in Montgomery County, in a quartz vein, from which 15,000 pennyweights (750 ounces Troy) were taken in a short period. This was the first true gold mine ever worked in the United States.

Gold was discovered in Habersham County, Georgia, in the Summer of 1829, and so abundant was the yield that the United States Mint received $212,000 of the metal during the next year. A large quantity of the gold was used for jewelry, and no record could be kept of it. The excitement attending these discoveries attracted from six to seven thousand gold seekers to the new fields, which led to the discovery that the whole Appalachian chain of mountains was more or less auriferous. In 1829 South Carolina sent $3,500 to the United States Mint. The active period of gold mining in the South extended from 1828 to 1845. When gold was discovered in California, in 1848, many Georgia miners came to our State, bringing with them the benefit of their experiences in the South, and it was from them that we learned to use the pan and the rocker, rude appliances, but of incalculable value to us during the early period of our western gold mining. Upon these primitive instruments we have engrafted our improvements, until our methods of gold mining, albeit still far from perfect, are the best that have ever been contrived. Now we can proudly say that our State is the model for the world. Our hydraulic apparatus has been sent to the most distant parts of the earth in the care of our most expert miners; and we teach the delvers of Africa, Spain, Australia, New Zealand, and the Southern States, to do well what the law no longer permits us to do in California. Our early Californians were assisted and instructed by miners from the southeastern States. We now return the compliment by sending them improved appliances, which they are using to good advantage; and, if I am not much mistaken, the more general working of the gold mines of the South will do much to restore the prosperity of the States in which the miners live.

MINERAL EXHIBITS MADE BY OTHER STATES AND TERRITORIES IN THE GOVERNMENT BUILDING.

In attempting to describe the minerals shown by other States, I am aware that I have undertaken a subject to which it will be difficult to do full justice. It is not my purpose to describe every mineral shown, but to state the general character of the exhibits and the impression they made on me. No doubt I overlooked some interesting and important exhibits, but this must be attributed to the vastness of the building and the profusion of the materials gathered together. The minerals mentioned in what is to follow I actually saw, and examined as carefully as the nature of the circumstances would admit.

ALABAMA.

Alabama was created a Territory March 3, 1817, and admitted as a State December 14, 1819. Its area is 50,722 square miles. Population in 1880, 1,262,505. The capital is Montgomery. Floor space occupied at the Exposition, 7,800 square feet. This State is divided into 66 counties. The northeastern portion is of a broken, mountainous character, from which the surface slopes southward to level, or nearly level plains. The extreme southern part of this State is low and flat. Some portions of the soil are poor, but generally it is well suited for agriculture, which is the principal business of the people. The crops are generally cotton and corn. The mineral resources of Alabama have only lately attracted attention; the chief products are coal and iron.

It is only recently that the existence of coal in Alabama has been brought to public notice. The South was supplied for many years from Pennsylvania, 2,000 miles distant, and from England, 5,000 miles away; while within 250 miles of tide-water in the Gulf of Mexico, lay these extensive fields. A notice of the coal lands of Alabama was published in *Silliman's Journal* in 1834. In 1850 coal began to be mined on the banks of the Warrior River, and was conveyed down that stream in rude flat-boats. With the extension of the railroad system the fields became more accessible, and were extensively worked. The great Warrior coal field takes its name from the river; it is very extensive, and the coal is of excellent quality, suited for the manufacture of iron, and for making coke. At the present time all the coal mined in Alabama is transported by rail, the principal market for it being New Orleans, Mobile, Galveston, Montgomery, Selma, and other towns in Alabama, Georgia, and Mississippi. Much of it is consumed in the manufacture of iron in Alabama and Georgia. In 1869 the yield from these mines was 11,000 tons, which increased so rapidly that in 1883 the output was 1,000,000 tons. The cost of mining a ton of coal and loading it on cars, does not exceed one dollar. Coke is sold at the ovens for $1 80 per ton. The cost of transportation to Mobile is $2 per ton, and to New Orleans $2 20 per ton. It is sold in these cities at $3 75 per ton. The productive coal field of Alabama is estimated at 5,350 square miles. The Pratt mines, which principally supply the iron furnaces of Birmingham, were opened in 1878. The company working them is known as the Pratt Coal and Coke Company. The openings are only six miles from Birmingham, to which the coal is brought by rail. There are fifty coke ovens at the mine, and

many more at the furnaces in Birmingham, running night and day. Most of the coke is used for the manufacture of iron.

By a fortunate circumstance, vast beds of the best quality of iron ores lie alongside these coal fields, while limestone, essential as a flux, is also found in the same locality. This association of minerals, and an abundance of cheap labor, make it possible to produce iron cheaper than in any other locality in the United States.

In April, 1885, I visited the iron and coal mines and furnaces at Birmingham. The town has an altitude of 596 feet above the sea level, and is admirably situated for manufacturing. Twelve years ago the site of this thriving place was occupied by a single farm house. The Birmingham Iron Works at the east end of the town were established in 1882. The first stack went into blast April twelfth, and twelve months later a second furnace went into operation, both of which have been running continuously ever since. The united capacity of both furnaces is 60,000 tons of iron per annum. The Mary Pratt furnace and plant occupy 30 acres of ground; operations were commenced April 7, 1883. The furnace is said to be one of the best and most complete of any in the United States; one hundred men are employed, and the daily output is 50 tons of iron, which, being of a peculiar character, is sold principally in Indiana, where such a quality of iron is required. The Alice furnace is the oldest in Birmingham; it was begun in September, 1879, and went into blast in November, 1880. There are two stacks. No. 1 is 63 feet high, 15 feet bosh, with a capacity of from 45 to 60 tons per day. No. 2 is 75 feet high, 18 feet bosh, with a capacity of from 75 to 100 tons per day. The ores are red and brown hematite. The product of these furnaces is sent to Cleveland, Chicago, St. Louis, Detroit, Terre Haute, Centralia, Louisville, Cincinnati, Evansville, Nashville, Chattanooga, Atlanta, and all southern cities. The quality of the iron is said to be equal to any made in the United States. The Birmingham Rolling Mills have puddling furnaces with a capacity of 100 tons per day. They make all kinds of soft iron, and use gas under the boilers, but help out with coal, which costs, delivered, from $1 15 to $1 25 per ton.

Red Mountain takes its name from its color, which is imparted by oxide of iron. It is estimated that there are 50,000,000,000 tons of iron in it; the only drawback to an unlimited production is the want of a market sufficiently large to receive it. The cost of transportation only, prevents competition with Pittsburgh and other northern iron manufacturing localities. The iron ore, coal, limestone, and sand, all being found in abundance within a radius of six miles, make it possible to produce iron at the low cost of $11 50 per ton, with a fair margin of profit. The Black Warrior River, an affluent of the Alabama, is navigable to Tuscaloosa, 378 miles from tide water. A joint memorial of the General Assembly of Alabama was sent to Congress, asking that the river above Tuscaloosa be improved at the expense of the Government, so that coal and iron from the vicinity of Birmingham could be cheaply conveyed to Mobile, where ships might be supplied and the joint product sent to United States coast cities and foreign lands.

Gold is found in Alabama in Cleburne, Talladega, Coosa, Randolph, Clay, Tallapoosa, Chilton, Fayette, and Marion Counties. These counties are in the general trend of the Apallachian chain of mountains; the gold occurs both in quartz veins and in alluvial deposits. It is the opinion of Eugene A. Smith, State Geologist, that forty years' working of the auriferous deposits have to a considerable extent depleted them, and at the time of the publication of his report, in 1884, there were no mills in operation.

The quartz specimens I saw were of two distinct characters: the granular quartz found in Georgia and North Carolina, and a glassy, flinty quartz in which I found a few specks of gold; but the specimens I prospected on my return to San Francisco, which were from Talladega, yielded no gold. The Talladega gold fields are situated on the East Tennessee and Georgia Railroad. The gold is said to be difficult to save, owing to the presence of talc in the rock. I obtained a specimen from the "Harold" mine, Clay County, nineteen miles east of Talladega. The quartz is glassy and hard, but shows free gold. The "Logpit" mine is in the same county, twenty-one miles east of Talladega. This information and the specimens were obtained from D. A. Smith, whom I met at Birmingham. Mr. Giles Edwards, of Birmingham, says that he knows of a gold placer in Alabama which will pay one dollar per day by panning. The total gold and silver from Alabama, deposited in the United States Mints up to June 30, 1883, was:

Gold	$222,729 90
Silver	6 15
Total	$222,736 05

The Alabama general exhibit at the Exposition was large and imposing. The mineral department, also large and important, was in charge of Wm. S. McNeill, of Mobile. Eugene A. Smith, State Geologist, was active in making the collections, but was not present in person. The State made no appropriation. There were two separate exhibits, one made by the Louisville and Nashville Railroad Company, which occupied the central part of the space, while the other consisted of State collections by the geological survey, and specimens collected and contributed by private individuals, by invitation of the Commissioner. As a whole, the collection was very full and creditable to the State and its friends.

In the geological survey collection there were shown a fine suite of silicified wood and carboniferous and tertiary fossils, including vertebræ of Zeuglodon cetoides. Among the coal fossils were several large stumps of Sigillaria. There were also some fine shell marbles on exhibition. Of fertilizers, there were marls and phosphatic nodules; of minerals, the most noticeable were asbestus in long fibers, barite crystals, chalcopyrite, corundum (of which there was a crystal 11 inches high and 5 inches in diameter), kaolin, limonite (needle ore), and a variety called kidney ore, in remarkably fine specimens and in large masses, from Blount County. Of ores, there were copper shales, gold quartz from the Blue Hill gold mines, Tallapoosa County, and Dadeville ore. The rock collection included building stones, feldspathic rocks, clays and fire-brick made therefrom, hydraulic cement, limestones and marbles, lithographic stone, etc.

The following is copied from a handbook of Alabama prepared for the Exposition:

BUILDING STONES, LIMESTONES, POTTERY MATERIALS, ETC.

The Alabama building stone was represented in the display furnished by the Ingleton Quarries and Steam Stone Works, Dickson, Colbert County, consisting of the following pieces:

Highly finished slab with name of the firm, letters in relief, beautifully sculptured and polished.

Architraves with inscriptions.

Cubical blocks of various sizes and finish.

Square oblongs, three to four feet long, four inches through.

Flat square pieces, similar length, one inch thick.

Large monumental tablet, resting upon a square base four feet in height, ten feet long, and over five tons in weight.

One half inch polished slab, two by four feet.
Slab of cloudy marble from Talladega.
Building stone of Lauderdale County.
Square block of red syenite, polished, Talladega County.
Fine grained limestone for building. Lauderdale County.
Square block of finished oolitic limestone. Lauderdale County.
Slab of same material.
Square flat piece of same material.
Finished windowsill of same material.
Square block finished building stone. Lauderdale County.
Square blocks finished building stone. Brown's Quarries, Colbert County.

These building stones, known as "Alabama building stone," from the sub-carboniferous strata, or mountain limestone, are ranked among the best building materials of their class. They are very compact, quarried in large masses without flaws, easily worked, of great resistance to atmospheric influences, and admit of a finish to make them applicable for various purposes in ornamental architecture. The polished marble tablet of the same material from Tuscaloosa represents the crystalline, white, cloudy, and gray marbles of great purity and softness of grain which occur in inexhaustible quarries in the belt of crystalline limestones that separates the lower silurian strata from the archæan rocks.

Cornice of white Talladega marble.
Crystallized limestone. St. Clair County.
Crystallized limestone, silicious. St. Clair County.
Limestone, used for flux at the furnaces of Birmingham. From the quarries at Blount Springs, Blount County.
Fire clay, invaluable in the construction of furnaces. St. Clair County.

Of fossils there were two long glass showcases filled with coal plants, some of which were magnificent specimens. The railroad company's exhibit consisted generally of large and imposing specimens, in which coal and iron were the prominent features.

Of minerals there were in this collection good specimens of yellow ochre. Of iron ores there were large masses of hematite, from Red Mountain, near Birmingham, much resembling the Clipper Gap iron ores of Placer County, California. Also large masses of limonite or brown hematite, from Jefferson County. A fine arch, supported on columns of iron and surrounded by manufactured ironware, stoves, castings, pig iron, chains, bars, etc., was exhibited by the Birmingham Iron Works. Between the iron columns was placed a high plate-glass case in which was shown a pyramid of broken pig iron.

ARKANSAS.

Arkansas was created a Territory March 2, 1819, and admitted as a State June 15, 1836. Its area is 52,198 square miles. Population in 1880, 802,525. Capital, Little Rock. Floor space occupied in the Exposition, 9,300 square feet. The State is divided into 64 couties.

A pamphlet was prepared by the Hon. C. M. Taylor, Commissioner, for distribution, from which the following is condensed. It was entitled

ARKANSAS' EXHIBIT AT THE WORLD'S INDUSTRIAL AND COTTON CENTENNIAL EXPOSITION, 1884-1885, AT NEW ORLEANS, LA.

ARKANSAS.

Arkansas was settled by the French in the year 1670, and was purchased by the United States, from the French Government, in 1803. The dimensions of the State embrace an area of 33,403,720 acres, about the size of England, and its climatic position is propitious, as it lies between thirty-three and thirty-six degrees north latitude, and between the meridians of eighty-nine and ninety-four degrees west longitude. It is bounded on the east by the Mississippi River; bisected by the Arkansas River; and the White, Black, St. Francis, and Ouachita all flow through it into the Mississippi.

Physical Geography and Soil.—The eastern part of the State, bordering on the Mississippi River, has an exhaustless alluvial soil, heavily timbered and adapted to the most profitable character of agriculture. Passing westward the surface gradually becomes more elevated. Near the center of the State it is rolling or hilly, while in the west the hills grow into mountains, of which the principal are the Ozark, with extensive reaches of table lands. North of the Arkansas River the landscape is beautifully diversified with hills, prairies, and woodland. The country between the Arkansas and Ouachita Rivers is

of a partly diluvial and partly alluvial formation, being composed of broad and fertile bottoms, with occasional ridges. South of the Ouachita it is divided largely between ridges and valleys, well watered by the numerous streams that rise in the hills and mountains of the west. Southward of these ridges and valleys, and extending to the southern boundary of the State, the country is generally undulating and overgrown with vast pine forests. The alluvial lands, covering a large portion of the State, are very fertile, and the greater portion of the hilly region is susceptible of cultivation, while for the growth of fruits, and especially the grape, no better land can be found.

MINERALS.—The coal fields of Arkansas are very extensive, covering an estimated area of 12,000 square miles, and in the valley of the Arkansas, where coal mining is most largely conducted, the beds run to nine feet in thickness. In quality analysis proves this coal to be fully equal to the Lykens Valley coal of Pennsylvania, which makes it first class, both for steam and for manufacturing purposes. In the hilly region, including Crawford, Dallas, Grant, Hot Springs, Independence, Izard, Lawrence, Madison, Pike, Polk, Saline, Sevier, Sharp, Searcy, Sarber, Van Buren, Montgomery, and Yell Counties, are magnetic, hematite, carbonate, and specular iron ore; manganese and associate metals; lead, antimony, zinc, marble, gypsum, kaolin, whetstone, slate, granite, marl, niter, and paint earths. The hematite iron beds in some places crop to the surface in acres of area, with limestone and timber in the vicinity for fluxing and charcoal. Sevier County claims the largest body of antimony, and Polk County the best deposit of manganese ever discovered. Soapstone is being quarried in Pulaski County, and the gypsum beds of Pike County promise to prove a source of great profit. Immense quarries of marble, pink and gray, are being operated in several counties, notably in Madison, and slate quarries are opened in Pulaski, Polk, Pike, and Sevier Counties, the slate, in point of durability, evenness of cleavage, and beauty of color, being equal to that which forms such a great source of profit in Vermont. The zinc ores of this State are represented to compare favorably with those of Silesia, and have a superficial area of thousands of acres. The vast mines of Arkansas may be regarded as a continuation of those of Missouri, which terminate, though broken at intervals, in the great iron mines of Texas. Never failing large waterpower and all the accessories for smelting and refining are contiguous to these deposits. In this region the most active powers of industry are destined to be the blast furnace, the rolling mills, steam and water power. Here, too, when capital becomes diverted from gambling to honorable industry, is promised a dense civilization in successful competition with the metal workers of Pennsylvania over the iron trade of Mexico and Central and South America.

WONDERFUL SPRINGS.—The Hot Springs of Arkansas issue forth from the Hot Springs Mountain at an elevation of 800 feet above the level of the sea. There are seventy-one of these springs, with a temperature ranging from 93 degrees to 157 degrees Fahrenheit, and discharging 335 gallons of water a minute. This water flows into a pretty mountain stream twenty-five feet wide, and causes a vapor to rise from the surface. Most of the springs are covered with stone and cemented, and many of them have an elevation of fifty or seventy-five feet above the valley. There is an abundance of gravity for sending the water into the upper stories of buildings. The water is conveyed through iron pipes to the great tanks and bathing-houses in the valley. The superintendent of the reservation has had two large tanks constructed, holding, respectively, 20,000 and 30,000 gallons, in which the water drawn in over night for use next day loses less than one degree in temperature. Composed of acids and mineral bases, the effects of this water in many forms of chronic diseases are wonderful. Its power, like that of the physician, probably consists in repairing drains by copious diaphoresis for the removal of obstructions that clog the system. An old physician, contrasting the curative powers of the springs with those of medicine for rheumatism, gout, neuralgia, erysipelas in all its forms, sterility and diseases of the kidney, illustrates his opinion by saying: "In those cases the human system may be compared to drainage, in which the mains and sewers are out of order. The right thing to be done in such a case is to remove the obstructions, instead of trying to dip out the accumulated silt and water with a ladle."

The Mammoth Spring, in Fulton County, is a phenomenon worthy of description. The main body of water, issuing from an opening a hundred and twenty feet in circumference, flows uninterruptedly at the rate of 8,000 barrels a minute, affording valuable power for manufacturing purposes. From compression, probably, so large an amount of carbonic acid is held in solution that the surface of the wonderful fountain is in a constant state of effervescence.

The Arkansas Industrial University, situated at Fayetteville, was established in accordance with the Act of Congress providing for "such branches of learning as are related to agriculture and the mechanical arts," without excluding other scientific and classical studies. By adequate State aid, Arkansas has carved out several professional chairs, and so imparted to the school the more substantial features of a university. The medical department has a full professorship, and the course of study embraces three years. Branching from the institution is the State Normal School for the education of colored teachers. It is located near Pine Bluff, and is one of the handsomest educational edifices in the State. The building is of brick with slate roof and trimmings of granite. It cost $12,000, and contains a large assembly room, four recitation rooms, and cloak rooms for both sexes. Besides the public schools, university and institutions for the blind and deaf mutes, there is a large number of private schools, seminaries, and colleges which are largely attended. For peace, civic virtue, and high social culture, the people of Arkansas stand as high as those of any other State in the Union. That the State has a fair-sized

crime record is not surprising when the advantage which its immense forests present as a hiding place for fugitives from the ends of justice from other States is considered; but it is satisfactory to know that as railroads and telegraph lines have become more extended, the crime record has fallen off proportionately. As for the citizens of Arkansas, they are a law-abiding, rights-respecting people, and plentifully supplied with churches and preachers.

Jay Guy Lewis, M.D., was in charge of the exhibit. The mineral collection was large and interesting. Of the specimens shown, the most valuable, and those of the greatest interest to the mineralogist, were the following:

Building and ornamental stones, including marbles, limestones, sandstones, granite, serpentine, porphyry, and slate.

Of the marbles there were shown a cretaceous inoceramus limestone; encrinal marble, a red crinoidal marble, and a sub-cretaceous limestone.

Also, five slabs of very fine quality and different varieties from Eureka Springs, Carroll County.

There were also some very handsome slabs and cubes of red marble.

The granite shown was of peculiar structure and very beautiful.

Among the minerals were large masses of blende; fine crystals of brookite; calamine in large masses; calcite of a green color; chalcopyrite disseminated through a flinty quartz gangue, which could be crushed and concentrated, but which I was informed does not occur in large quantities; coal from Little Rock in large blocks; similar specimens of bituminous and semi-bituminous and semi-anthracite coal; clays of refractory nature, suitable for the manufacture of fire-brick, samples of which were also shown.

A special exhibit of earthenware was made by the Little Rock Pottery Company. It embraced articles useful and ornamental, some of which were quaintly artistic, showing grotesque forms of animals and reptiles. Of fossils there was a fine collection from the carboniferous, including coal fossils, and a well displayed collection of tertiary fossils, prominent among which was the tooth of an elephant. Gypsum was shown in large blocks, and selenite in fine crystals; also satin spar. Of glassware a special display was made by the Marrieton Glass Works.

Magnetite, natural magnet or loadstone, manganese ores, pyrolusite in large quantities, psilomelain, novaculite or Wachita oil stone, rough and manufactured, was shown in large masses, blocks, and slabs of three varieties—Arkansas hone stone, Wachita oil stone, and Elixter water stone. Yellow ochre of good quality was also shown.

There was a good display of the ores of copper, gold, iron, and silver.

Of quartz there were some magnificent specimens from the Hot Springs. A special exhibit was made by J. M. Blake, who showed fine crystals, both native and cut into various ornamental forms, such as charms, sleeve buttons, pins, and other jewelry. Also a bottle, an anvil, and a cask cut in crystal without a flaw; the latter was the largest crystal, cut into a special form and highly polished, of which I have any knowledge. There is only one imperfection in it—an inclosure, that it might be very interesting to study microscopically. The cask is about eight inches long, and five inches in diameter, and weighs about ten pounds. It is surrounded by four hoops of gold. I cannot make up my mind whether the latter adornments are appropriate or a blemish to the artistic character of this interesting object. A magnificent specimen of crystals in a single group was purchased for the California State Mining Bureau, and is now placed in the State Museum. It is said to be the finest ever taken from the locality, and is perhaps the finest in the United States.

Among other minerals worthy of mention were schorlomite, good speci-

mens of smithsonite, steatite, stibnite, perofskite in fine crystals, and black tourmaline.

A fine special collection was shown by the Biological and Geological Department of the Arkansas Industrial University of Fayetteville, Washington County. It was displayed in seven table cases, one of which was devoted to metalliferous ores and the results of assays, and cupels upon which were beads of gold or silver. Other cases were devoted to galena and zinc ores, and one to quartz crystals from the Hot Springs. The fossils mentioned elsewhere were included in this collection.

Gold has been found in White County, but has never been worked with profit.

COLORADO.

Colorado was created a Territory February 28, 1861, and admitted as a State August 1, 1876. Area, 104,500 square miles. Population in 1880, 194,327. Capital, Denver, which is also the principal city. Floor space occupied at the Exposition, 6,600 square feet. The State is divided into 21 counties, and was formed from portions of Kansas, Nebraska, New Mexico, and Utah. It is traversed by the main range of the Rocky Mountains, and contains some of the highest peaks in the United States, rising to an elevation above 14,000 feet. It may be considered as consisting of three great natural divisions, viz.: the mountain ridges, including the "Park" system; the "Piedmont" or "foothill" region; and the plains. The mountains abound in minerals and mineral springs, and gold, silver, and lead are largely produced, seventy per cent of the former coming from Gilpin, Clear Creek, Boulder, Park, and Lake Counties.

The principal silver mines are in Clear Creek County, the development of which commenced in 1869. Iron, coal or lignite, clays, and salt, are important mineral products.

Colorado possesses great agricultural as well as mineral resources, and is capable of supporting a large population, but like California, and most of the great Western States and Territories, it owes its present and immediate prosperity to the discovery of gold within its borders. This occurred after the great and important era of the discovery of gold in California, which led to the finding of the precious metal in Australia, New Zealand, and the Western States of the Union, and gave a fresh impetus to the prosperity of the world. The first discovery of gold in Colorado was made in 1852 by a Cherokee cattle trader, near the mouth of Clear Creek. The first mining district was organized by N. G. Russell, a Georgian, who, in 1858, discovered gold on Dry Creek, about seven miles south of the present site of Denver, in 1858. The "Pike's Peak" excitement and immigration followed this discovery. The deposits of Colorado gold and silver in the United States Mints up to June 30, 1883, were:

Gold	$41,958,869 48
Silver	22,386,458 79
Total	$64,345,328 27

The State made no appropriation for the New Orleans Exposition. Its magnificent exhibit was made by the exertions of private individuals. The mineral exhibit was not only large but imposing, the ores and minerals being shown in quantities; piles of ores containing in some cases more than a ton, conveyed to the mind the impression that the ores were to be found in that prosperous mining State in great abundance. This was the case with most of the States and Territories of the Great West, a lesson learned

at the Denver Exposition, at which the large quantities of ores shown was a special feature.

Colorado showed but few special minerals. The main idea seemed to be to call attention to the economic minerals and to their abundance.

Boulder County showed piles of ores, principally galena and pyrite and mica in tolerably large sheets, but of inferior quality. A case was devoted to a collection of fine telluride ores. The Van Buren Mine, Central Mining District, Richmond Mine, Gold Hill District, and other noted mines were represented.

The Gilpin County exhibit was in charge of Dr. A. C. Hall. It consisted of large piles of ores and a monument. the base of which represented the silver produced by the county, $5,000,000, and the shaft the gold product from 1859 to 1885, $45,000,000.

The first gold quartz vein found in Colorado was discovered May 6, 1859, by John H. Gregory, in what is now known as the Gregory Mining District in Gilpin County.

Gunnison County made a fine display of ores and minerals, among which were coal, iron ores, silver lead ores, and freestone. Of special minerals there were shown: Amazon stone in magnificent crystals associated with smoky quartz, also in fine crystals, and very fine specimens of astrophyllite and cerusite in splendid interlaced needle crystals.

The Counties of Lake, Eagle, and Chaffee, were represented by Lewis R. Sharp, as Special Commissioner. This exhibit was very fine and extensive. Leadville, Lake County, exhibited piles of lead bullion, and the Leadville Smelting Works piles of lead and silver, and fine specimens of gold in leafy flakelike crystals, resembling California specimens from the Cedarberg Mine in El Dorado County.

From Pitkin County a general collection of ores was sent by the Denver and Rio Grande Railroad Company.

An exhibit of muffle furnaces, fire-brick muffles, crucibles, etc., all of good quality, was made by the Denver Fire Clay Company.

Clear Creek County was represented by piles of ores, principally gold. In a special case were shown fine specimens of galena, beautifully crystallized, from the Stevens mine.

A peculiar feature of the Colorado exhibit was a scene painted and displayed like theatrical scenery, of mountain views and landscapes, including the Mountain of the Holy Cross. In front of this artistic work was a beautiful garden and miniature ornamental grounds.

CONNECTICUT.

One of the original thirteen States. Area variously estimated at 4,674 and at 4,750 square miles. Population in 1880, 622,700. Capital, Hartford. Floor space occupied at the Exposition, 6,468 square feet. The State is divided into 8 counties. Its surface is diversified by numerous hills, of which the "Blue Hills" present the highest elevations. Mines are but few in number. Copper is found in limited quantities, and argentiferous lead mines have been worked at Middletown. There are also deposits of sulphate of baryta, limestone, flagstone, marble, granite, good brick clay, feldspar, etc., and several mineral springs are known to exist.

The collective exhibit was made by the State. The mineral portion was not large but was interesting. There were two table cases of choice crystallized minerals, all exceptionally fine. The style of arranging the specimens and the mode of labeling them was very elegant. Each specimen was placed on a thin block beveled on one edge. The block was painted

black, which offered a relief to the white printed label and the mineral itself. The labels were on slips, with names of species in large black type, and were fastened to the block by two small round-headed nails. The effect of this arrangement was very fine.

A large slab of sandstone was exhibited on which the tracks of some animal were finely shown. A similar specimen will be sent to the California State Mining Bureau. There were blocks of freestone and granite, each a cubic foot in size, to illustrate the character of the best building stones of the State; also large rough masses of quartz and orthoclase feldspar, suitable for mixing, when pulverized, with clay or kaolin, for the manufacture of porcelain—these were from Glastenbury.

While the mineral exhibit from this State was small, it contained features of much importance, and was specially noticeable from the regard to cleanliness shown in the arrangement and care of the specimens. The minerals were sent by the Wesleyan University.

DELAWARE.

One of the original thirteen States. Area, 2,120 square miles. Population in 1880, 146,608. Capital, Dover. Floor space in Exposition, 3,600 square feet. The State is divided into 3 counties. It is not in any particular a mining State. There are no mountains, although the northern part of the State is somewhat hilly. The principal minerals are iron and clay, or kaolin. The mineral department was represented by two small cases of rocks and minerals, in one of which iron ores, kaolin, dolomite, orthoclase, mica, etc., were shown. The other contained specimens illustrating the geology of the State, collected during the survey made by James C. Booth in 1837–38, and Fred. D. Chester in 1882–84, with section. It was interesting but small. Elsewhere in the general exhibit were shown manufactured iron: axles and carriage and wagon hardware, boiler plates, sheet iron, galvanized and corrugated, and window glass.

FLORIDA.

Created a Territory March 30, 1822. Admitted a State March 3, 1845. Area, 59,268 square miles. Population in 1880, 269,493. Capital, Tallahassee. Floor space in Exposition, 8,325 square feet. The State is divided into 39 counties. Florida is not a mineral State; it is nearly level, the highest land being only a few hundred feet above the sea. The notable minerals shown were amethyst, lapis lazuli, lignite, and iron ores. The iron ores are not worked, but were smelted on a small scale during the war. They are from Levy County. Samples of clay and brick were on exhibition from Bellevue Brickyard, Escambia County, West Florida. An interesting sedimentary coral rock, resembling fine-grained pisolite, from Key West, was shown. It is used in building.

One of the most attractive features of the Florida exhibit was a beautiful relief map of the State, horizontal scale two miles to the inch, vertical scale fifty feet to the inch. It was much admired. I regret I cannot describe the fine exhibit, made by this State; other than mineral.

GEORGIA.

One of the original 13 States. Area, 58,000 square miles. Population in 1880, 1,542,180. Capital, Atlanta. Floor space at Exposition, 3,937 square feet. The State is divided into 136 counties. The surface is greatly

diversified. Along the coast and Florida line the country is low and swampy, the elevation for twenty miles or more inland being not more than forty feet. From thence it gradually rises to the summits of the Appalachian Mountains. The highest elevation in the State is Enota Mountain in Towns County, which rises 4,798 feet above the sea. This would not, however, be considered a high mountain in California.

A general description of the country in which the principal minerals are found has been given elsewhere.

The State made no appropriation to exhibit its resources in the Exposition. The really fine display was by individuals.

The minerals were arranged in eight plate-glass table cases, and in heaps on long side tables. The crude ores and minerals were shown in considerable quantities.

The minerals most worthy of special mention were: building stones; coal; copper ores; corundum, in fine crystals and in large masses; dolomite; gold quartz; gold ores, pyritic; limonite; hematite; iron ores (one variety called honeycomb limonite); limestone, used as a flux in iron smelting; limonite, stalactitic; limonite, geodetic; called pot ore; manganiferous iron ore (spiegeleisen); marbles, several varieties, one pink colored, resembling onyx, aragonite; pyrite, containing chalcopyrite, very solid and suitable for the manufacture of sulphuric acid, copper, and other products.

The choicest and best arranged specimens displayed in the table cases mentioned, were from the private collection of N. P. Pratt, Associate United States Commissioner. The following were the most interesting among them: amethyst crystals; anthophyllite; asbestus; barite in fine crystals; buhr stone; beryl in fine large crystals; chlorite; chrysocolla; corundum, in fine crystals, one five inches longest diameter. There were also crude emery, and emery wheels and slabs in great variety. Copper, native; genthite; graphite; gypsum; haloysite; hematite, one variety stalactitic and botryoidal; hornblende; limonite after pyrite, very fine; magnetite; margarodite on corundum; mica in large sheets and of excellent quality; mica hexagonal in good crystals; opal; ochre, fine; peacock iron ore, limonite(?) with iridescent surface, colors purple and green, very fine; pisolite; psilomelaine; pyrolusite, needle crystals, fine; ruby corundum, fine; rutile; sapphire, fine blue; smoky quartz crystals; staurolite; steatite; tourmaline, black.

Several Southern railroad companies made exhibits of Georgia minerals. The following paper was specially prepared for the Augusta *Chronicle*, centennial edition, 1885:

THE GEOLOGY AND MINERAL RESOURCES OF GEORGIA.

The topography of a country is always intimately related to its geological structure. The mountains, valleys, and plains are resulting features dependent primarily upon the character of the rocks. The mountains and ridges of Georgia, probably without an exception, owe their relative elevation above that of the surrounding country to the greater capacity of their rocks to resist the erosive influences of the atmosphere, and not to independent upheavals, according to the popular idea of their origin. Throughout middle and northern Georgia the strata lie in a series of great folds, and the beds of rock outcrop at all angles between the horizontal and the vertical; in this way the harder and softer materials of the formations are successively brought to the surface, and the streams, naturally selecting the softer beds, have washed out the hollows and valleys, leaving the harder layers on the higher grounds. This is well illustrated in northwest Georgia, where the valleys are scooped out of the softer shales and limestones, while the more resisting sandstones and conglomerates are left behind in the general wearing down of the country, and now enter into the structure of the mountains. A geological section here shows the strata in folds like a fluted ruffle, and the mountains, with few exceptions, are situated on the synclinal or downward folds, so that the valleys, rather than the mountains, are on relatively "upheaved" strata. A plausible explanation of this fact is suggested in the evident tendency of an upward flexure to loosen the texture and promote the disintegration of the rocks, while the downward fold tends by compression to

harden them. Whatever may have been the original surface of the country, the present features are largely, if not altogether, due to erosion controlled by the elevation above tide and the other conditions alluded to as favoring or resisting its action.

The northern part of the State is diversified with elevated table lands on the northwest and high mountain chains on the east, with a broad intervening valley subdivided by long lines of ridges. This section abounds in magnificent scenery of the most varied character. The Lookout table-land rises to an altitude of twenty-four hundred feet above the sea, and the Blue Ridge Mountains to nearly five thousand feet above the sea and four thousand above the Oostenaula Valley.

Middle Georgia has a rolling or hilly surface, and resembles the more northerly part of the State in the general northeasterly trend of the ridges. This region is comparatively level, and its mountains, with few exceptions, on such elevations as would hardly receive the distinctive name of a ridge in northern Georgia. Stone Mountain, in DeKalb, is a cone of denuded granite standing six hundred feet higher than the adjacent country. Graves Mountain, in Lincoln, and Pine Mountain, in Harris, are elevations of a few hundred feet, which are conspicuous features in the landscape.

Georgia has within her limits nearly all the geological formations, and perhaps every variety of mineral that can be found on the eastern side of the continent.

The Archæan or Metamorphic covers the larger part of middle and northern Georgia. This is defined on the south by a line crossing the State at the heads of river navigation from Augusta to Columbus, and passing near Milledgeville and Macon, and in the northern limits by the Cohutta, Allatoona, and Dug Down Mountains.

The formation is made up largely of different series of granites, gneisses, and mica schists, each, when it constitutes the country rock, giving rise to peculiarities of surface, soil, and growth. The gray granites and gneisses afford the gray gravelly soil that characterizes the larger part of this section of the State, while the syenitic or hornblende granites and gneisses gives rise to the red clay soils, and some of the mica schists to the sandy areas. The thickness of the formation has been estimated at twenty thousand feet. It is divided into two principal groups, the Laurentian and Huronian. The latter, which is the upper portion of the series, is thought to be represented in the gneiss, chloritic beds, conglomerates, and slates of the Cohutta region in northern Georgia. Until recently the rocks were believed to be non-fossiliferous, and the name of Azoic Age (without life) was given to the formation, but the discovery some years ago of a fossil, the eozoon, in the Laurentian of Canada, carries the horizon of earliest known life many thousand feet downward.

Minerals of economic importance are found in every part of this wide metamorphic area. Gold in greater or less quantity is distributed throughout the section, but has been found in paying quantity principally in five belts crossing the State with the general trend of the rocks and hills in a northeasterly and southwesterly direction. One of these follows the course of the Chattahoochee River from Habersham to Troup. The others extend approximately parallel with this, two on the north, each side of the Blue Ridge, and two south of this, in middle Georgia.

The gold fields north of the Chattahoochee were the first discovered, and have been the most extensively worked. The gold region elsewhere in the State has been very incompletely explored, and in larger areas in which this mineral may be expected it has not been looked for. Prospecting with pick, shovel, and pan ceased at the outset of the California gold excitement, and it is only where gold was found in paying quantity by the pioneer with such rude appliances that more extensive mining is now carried on. In middle Georgia the country is less broken, and the rocks more generally covered with soil and other products of their own decomposition, and rich veins and placer deposits may lie deeply buried beneath this detritus.

Silver, lead, copper, and pyrite are found either within the gold belts or extending parallel and in close proximity to them. The last named mineral, until recently regarded as almost worthless, is now mined in this State for the manufacture of sulphuric acid. It is commonly accompanied by copper, silver, lead, and other minerals of value, but exists in many localities in sufficient close proximity to railroads to be profitably mined for the sulphur alone.

There is a long list of other valuable minerals peculiar to this metamorphic region. Among the more important and abundant of these are mica, asbestus, corundum, talc, graphite, kaolin, soapstone, manganese, baryta, and magnetic and other iron ores.

The best and most desirable building material may be had in the granites that extend in three or four ranges quite across the State. Three principal varieties have been observed. The gray granite, of which that found near Atlanta is typical, is composed of quartz and feldspar, with a dark colored mica. A syenite, or dark granite, is found on the eastern side of the State, in which hornblende is a constituent, and a granite found north of Augusta, Macon, and Columbus, near the southern limits of the metamorphic, contains a pink feldspar that, combined with the other materials, give a flesh color to the stone. The varying proportions among the constituent minerals in each of the kinds here mentioned multiply the varieties in shade of color to an almost infinite extent.

Marble, fine in quality and of the most durable character, is found in a belt of country extending through the Counties of Fannin, Gilmer, Pickens, and Cherokee. Associated with the white statuary marble of this lode are colored and variegated marbles in great variety.

The silurian, devonian, and carboniferous formations occur in the northwest counties, with an aggregate thickness of more than ten thousand feet. The beds are more or less

fossiliferous throughout, and consist of alternating series of limestones, slates, and sandstones, or conglomerates. The silurian is found in ten counties, and the devonian and carboniferous in seven.

The coal measures are confined, principally, to the Counties of Dade, Walker, and Chattooga, and covering an extent of two hundred square miles. Throughout this area there are from two to five beds of coal, some of which are worked at Coal City, in Dade County.

In the undeveloped coal field of Lookout Mountain, the beds have been worked to a very limited extent in a few localities, only for the neighboring blacksmith shops. The beds of coal, where naturally or accidentally exposed, vary from a few inches to five feet in thickness, and but few explorations have been made for the discovery of the beds when not thus exposed.

Encircling these coal fields, or extending parallel with them at short distances, are ridges with inexhaustible supplies of iron ore. These red ore beds at their outcroppings have a linear extent in Georgia of one hundred and twenty miles, and underlie extensive areas. East of this, in the same section of the State, the limonite, or brown ores, occur also in vast quantities.

Among other minerals of this section, now known to exist in quantity, may be named manganese, baryta, halloysite clay, variegated marbles, hydraulic cement, yellow ochre, limestone, roofing slate, and a variety of building stones. In addition to these, petroleum, gypsum, and galena are known to occur here in a number of localities, and may be found hereafter in paying quantity. Most of the lead of commerce comes from a geological formation in the northwest that is represented here by large areas, and in which the mineral has been found already in small quantity.

The building stones of this region exist in great quantity and in many varieties. The Tennessee varieties of red variegated marbles are found in Whitfield, flesh and dove colored marbles in Polk, and other shades, from nearly white to black, are found here and in other localities of this section.

The cretaceous and tertiary formations of the State remain to be mentioned. The cretaceous covers a triangular section lying south and east of Columbus. The surface is here somewhat more broken than in other portions of southern Georgia; but aside from this, there is little in the surface features to distinguish it from the country south of it. The marl beds contain phosphates and glauconite, or green sand.

The tertiary beds overlie the cretaceous, covering it entirely, it is thought, east of Macon, and extend in a broad, sandy area into Florida and to the estuaries along the coast. The surface is rolling near the larger streams, and in what is known as the lime-sink regions, but elsewhere nearly level. The country rises from the coast in two or three parallel terraces, reaching an altitude of about five hundred feet above tide near the northern limits of the formation.

The principal timber is that of the long-leaf pine, but the growth includes most of the varieties found elsewhere in the State, with bays, cypress, palmettoes, and others of a semi-tropical type not found further north.

Of the valuable mineral deposits of this section the clays are among the most important. An extensive deposit of white clay of the best quality for fine pottery is found near Augusta, and extends for some distance across the State in the direction of Macon. Buhrstone and marl beds cover a large part of the State south of these clays. Marl is found throughout this section, either outcropping on the hillsides or banks of streams, or at moderate depths below the water level of the country. Some of these beds in character approach nearly to that of a pure chalk.

The buhrstone is associated with the marl beds, but covers a less extent of country. It is found in heavy beds on the Savannah River, and at other points on the eastern side of the State, and is pronounced equal in all respects to the best French.

Lignitic coals, yellow ochre, timber, and opal may be found in several localities.

Quarternary deposits cover a low section of country bordering on the coast and extending in width from ten to twenty miles from the coast, embracing the palmetto and live oak region of the State.

Marls and phosphates have been found in a number of localities. Little search has been made for phosphates and valuable deposits. They probably may be found in this section.

Some only of the more abundant minerals have been mentioned in the order of the geological formations to which they belong. To name all now known to occur here would make up nearly the entire list of useful minerals and extend this article much beyond the designed limits.

Georgia is not equaled by any of the older States in her mineral resources, surpassing most of them in the abundance, and all in variety. But it can hardly be said that she is ahead of the hindmost in their development. Her coal is to a large extent unworked, and also the iron ores. With mountains of granite and marble she goes to Vermont for material no better or superior. With oolitic limestone in north Georgia crumbling beneath a profusion of better material, she goes to Indiana for rotten limestone with which to build a capitol, and so through a long list of materials existing at home and purchased from abroad. The most important sources of future wealth to the State now lie dormant in her undeveloped minerals and water powers. With the latter might be done the manufacturing for the world. The development of these would give a powerful stimulus to all other industries, and it is the highest interest of the State, and the noblest aim of her statesmanship, to promote its accomplishment.

Georgia contains gold fields of great extent and importance, and of an entirely different character from those of our Western States and Territories. For this reason I was specially interested in the mineral exhibit of this State, and visited some of the principal gold localities, knowing that I should find much that, when written, would interest our California and Western gold miners.

Gold was discovered in Georgia in 1828. In twenty years the placers were practically exhausted, after which veins and deposits began to be worked, as at present. The gold belt is about one hundred miles wide, and extends from North and South Carolina to Alabama, in a direction northeast by southwest, across the northern and eastern portions of the State. The first gold discovered was on the present line of the Marietta and North Georgia Railroad, near Jasper. The White Path gold mines, six miles northeast of Ellijay, were worked shortly after the Coosa mines, and much resembled them. The rush to the gold placers was like that to the Pacific Coast in 1849. The miners encroached on the Cherokee reservation, and even the United States troops could not keep them from the Indian lands. This period was known as the "Intrusion," and became an era from which Georgia mountain men reckon dates. In 1830 the Indian Territory was purchased, and the country called Cherokee was afterwards divided into several counties. The gold lands were obtained from the Indians by treaty, and immediately divided into forty-acre lots by lines running north and south, east and west. The lots are arranged in districts, numbered from 1 up, and run as high as 1,296; some districts are much smaller; I think the average is about 1,224 lots in a district. This system is at first very perplexing to one who has been accustomed to the surveys of California and the newer States.

The following counties in Georgia contain gold: Carroll, Cherokee, Cobb, Dawson, Fannin, Forsyth, Gilmer, Gwinnett, Habersham, Hall, Lincoln, Lumpkin, Paulding, Pickens, Rabun, Towns, Union, White. At the close of 1883, by report of the Director of the Mint, there were 600 stamps in Georgia, most of which were in operation.

Gold is found in Georgia as in California, in river placers and in place in quartz veins, but the great gravel deposits of California have no representative in that State. The river placers much resemble those of California, and the method of working them is similar. The gold is generally clean, but some specimens from the Keystone placer claim, near Dahlonega, which I examined microscopically, were somewhat coated (rusty). The Keystone claim is in the bed of the Chestatee River, three miles south of Dahlonega. Mr. Stewart, the Superintendent, showed me a vial of gold, coarse and clean, of an ounce or more in weight, which much resembled the best of California placer gold. He has some difficulty in saving the rusty gold, but there is only little of it. It is now proposed to turn the entire river from its bed in a flume, and to work it as in California.

The quartz gold of Georgia is generally clean and free from coating; amalgamation takes place immediately on contact with mercury. The following is the result of an examination and assay of an average specimen from Wellborn Hill, Union County, made since my return:

Percentage of gold	.0153+
Ounces in ton of 2,000 pounds	4.47
Value per ton	$92 40

The gold was very yellow and bright. A specimen from the Ralston Mine showed gold in the form of thin leaves. At first glance the specimen resembled those artificial preparations of gold leaf, sometimes used by unprincipled

miners to deceive the unwary, but a close examination under the microscope showed the gold to be natural and in place. I had the curiosity to measure the thickness of these leaves in decimals of an inch with a Jackson micrometer, and found them to be .00125+, or 800 leaves to the inch. The quartz in which the gold is found is generally granular when pure, somewhat resembling loaf sugar, and it has a singular resemblance to itacolumite, which is quite abundant in the gold regions of Georgia and North Carolina. "Itacolumite is a schistose quartz rock, containing mica; the finer kind is sometimes flexible" (Dana). "Schistose quartzite, in which the quartz granules are separated by fine scales of mica, talc, chlorite, and sericite" (Geikie), "sometimes contains native gold and diamonds" (Von Cotta). Having conceived the idea that the gold-bearing quartz of Georgia and the flexible sandstones called itacolumite might be identical, I commenced a series of experiments which proved very interesting. Selecting a specimen of itacolumite from Georgia I subjected it to a critical microscopical and physical examination. It was found to consist of granular transparent quartz, associated with a very small quantity of a dark colored mineral in angular fragments, with an occasional scale of a mineral resembling mica. There was not enough of the dark colored mineral to give it a distinctive character, much less to impart to it the property of flexibility, which it had to an eminent degree. When the auriferous granular quartz was compared with it side by side on the same glass slide, the appearance was exactly similar, except for the presence of the foreign mineral mentioned, which was absent in the granular quartz. This examination shows that the so called Georgia itacolumite does not answer the description given by the geologists. A number of samples were then prospected for gold, but none was found.

A typical specimen of the auriferous quartz from Wellborn Hill was then examined. One portion was concentrated in a horn spoon and the gold collected and weighed; the percentage did not materially differ from the sample mentioned above. 10 grams of the quartz was boiled in nitro-hydrochloric acid, the residue, 92.3 per cent, consisted of pure transparent quartz; some black non-magnetic particles observed in the original sample, were wholly dissolved. The soluble portion was examined and found to contain iron only, with perhaps traces of other substances, which in the rough examination were ignored. The specific gravity of the rock was 2.654. It is so easily pulverized that it can sometimes be crushed between the fingers like loaf sugar. At Wellborn Hill I made all my tests by crushing the quartz on a stone with my geological hammer. Mr. Melville Attwood has presented the State Museum a specimen of auriferous granular quartz from the Telluric Gold Mine, San José, Minas Geraes, Brazil, which bears a singular resemblance to the Georgia quartz. Connected with all the gold mines is a peculiar, very ferruginous rock, universally called "brickbat," because it breaks into cubical masses resembling in color and form an ordinary broken brick. It is light, soft, easily crushed, and decomposes into the red characteristic soil of the district. It is possibly the source of the iron beds found in the same region. It is probably sedimentary and lies conformably on gneiss or mica schist, in which all the quartz veins are found. It has been prospected frequently and found to contain no gold that can be collected. It may, nevertheless, be the mother of the placer gold; it seems also to be allied to itacolumite, and is probably a variety of it. The specific gravity is 1.584. Boiled in nitro-hydrochloric acid 28 per cent dissolves. The residue, still containing some undissolved black particles, is found to consist mainly of grains of transparent white quartz, like the gold-bearing rock. On being decomposed with alkalies it yields 51.5 per cent of silica. The

residue consists of alumina and sesquioxide of iron, with perhaps traces of other substances. No lime or magnesia were found.

Approximate analysis of brickbat after drying in water bath:

Silica	41.60
Alumina	26.06
Sesquioxide iron	32.34
	100.00

When wet it smells strongly of alumina. It absorbs 20 per cent of its weight of water, giving off at the same time air, which rises in small bubbles.

The brickbat decomposes to ochre and sand and changes to hematite, forming successively the yellow and red ochres so common in the gold regions.

It is easily disintegrated, and with water forms a soft yellowish-red, somewhat plastic mud. Placed in a Schultz apparatus and washed with water under small pressure, a golden yellow, fine-grained ochre flows over the edge of the vessel. What remains when the water flows clear, is redder in color. On increasing the pressure or head, a second portion overflows, leaving a small residue of coarser particles or sand in the following proportion:

Ochrous portion	94.45
Sandy residue	5.55
	100.00

The residue, when seen under the microscope, appeared to be particles of quartz enveloped in limonite. As this could not be disintegrated without crushing the quartz, it was boiled in nitro-hydrochloric acid, by which treatment a portion of the envelope was dissolved; a portion rendered flocculent was removed by washing. A small portion of quartz showing a curious cellular structure remained. None of the particles were rounded, but all were angular, like the finer particles of the auriferous gravels of California.

MANNER OF WORKING THE AURIFEROUS MATERIAL.

It has been stated that the quartz veins, which are generally small and not continuous, are found in a micaceous schist lying on gneiss. The schist is easily disintegrated, and contains gold probably derived from the decomposing quartz. I saw no special quartz vein worked as in California. The system of collecting the gold combines the hydraulic and milling process. The workings are connected with the mills by long lines of sluices, made like the common placer sluice-boxes of California, but somewhat larger.

Water is brought to an elevation sufficiently high above the workings, which are open cuts, to give about 100 feet pressure. The water is frequently pumped up by steam engines, which seems a strange feature to a Californian. From small pressure boxes the water is conveyed in eight-inch pipes to small nozzles, with orifices not over two and one half inches in diameter. The water is projected in feeble streams on the soft micaceous schist which passes in the form of mud down the sluices to reservoirs near the mills, which are sometimes at long distances from the workings. When sufficient matter has accumulated, the gateway of a small adjacent reservoir is opened and the material is "boomed" into the mill, where it settles on the floor behind the batteries in a muddy mass; 250 inches of water are used in booming. The floors are made water tight, but there is a fine grating which allows the excess of water to run off. The stuff to be crushed consists of soft mica schist, bits of gold quartz, a large quantity of brickbat, and a small

portion of gold. The stuff is fed into the mills and amalgamated in the battery. The gold is free and amalgamates readily. I have never seen copper plates kept in better condition than in these mills. This is owing to the fact that the rocks contain no sulphurets or anything to contaminate the mercury. In the sluices there are placed riffles consisting of four or five scantlings, connecting by cross cleats one inch square, which are placed downward, and extending across the sluices, beneath the scantlings, form riffles at which gold and heavy matter collects. Quicksilver is poured in at times, which serves to save the gold, some of which is collected before reaching the mills. The sluice boxes are cleaned up at stated periods by taking out the lower riffles first and washing down the concentration to a large cleat placed across the sluice. The final cleaning up is made in a miner's pan as usual. No blasting is ever used to assist the streams in disintegrating the soft rocks. The whole operation is on a very small scale, but the methods are economical and the results are said to be satisfactory. The cost of mining and milling at the Barton and Hand and Ralston and Gordon Mines, near Dahlonega, is estimated by the Superintendent at $22\frac{1}{2}$ cents per ton, and the average yield of gold two dollars per ton. If quartz only was milled, the yield would be very much greater in proportion to the amount crushed, but it is a question if it would pay better than the cheap system now employed. It occurred to me that it would be an improvement to pipe down through sluices as now, but to shoot off by means of a grizzly all the larger fragments of quartz, brickbat, etc.; to hand-pick the quartz which contains all the gold not already free, and to throw it up in piles. The finer matter which passed through the grizzly could be treated as in California, in block-paved sluices with mercury, and on undercurrents, by which the free gold would be practically saved without the use of the mills. After the sluices were cleaned up they could be used to boom down the quartz if that mode of conveyance should still be found cheaper than hauling to the mills by teams. I am convinced that large quantities of float quartz could be gathered on the surface that would pay to work in a mill. This could be ascertained by making a multitude of horn spoon tests of the float quartz. The prospectors employ the most primitive methods of testing the quartz; but few have seen a horn spoon or know of its use. I saw a skillet used instead of a miner's pan, and did not observe in any of the mining localities I visited, a batea, or any convenience for pulverizing quartz, or for systematic prospecting. Most of the tests were made on a shovel and the crushing done in the crudest and most imperfect manner. I am satisfied that more gold could be saved if these mines were more carefully and systematically worked. This is easy to say, but it is not so easy to suggest a material improvement without more carefully studying the conditions, and perhaps by using the experience gained by those who have long worked the deposits. I observed here the operation of the universal law that governs the production of gold. If it was not difficult to obtain it would have but little value. I was pleased to notice the Howland riffle, a California invention, in use, and to learn that it gave great satisfaction. When compared with similar operations in California these workings seem insignificant. There are no costly bedrock tunnels. The sluices are small and there is no dump as we understand it in California. The quantity of water used and the pressure are small, and the hydraulic apparatus quite diminutive. No paving blocks, undercurrents, blankets, concentrators, chlorination works, electric lights, telephones, derricks, hoisting works, or rock breakers are used, nor is there an assay office at Dahlonega, the center of the Georgian gold fields. But the mills are well built and well managed. The stamps are generally lighter than ours, but on the other hand the material is very easily crushed.

The mills are generally run by water power and are kept clean and in good order. Tar is used instead of grease on the cam shaft, which runs down and gives that part of the mills an untidy appearance, but otherwise it is found to be better than grease, as it does not interfere with the amalgamation if a portion falls into the battery.

The principal productive gold mines of Georgia are in the vicinity of Dahlonega. They are in what is known as the Findley belt and the Pigeon Roost sand vein or mineral belt. The Findley group are the Findley, Singleton, Griscomb, Fish Trap, and Cleveland. The Pigeon Roost group are Ivey, Pigeon Roost, White, Chicago and Georgia, Dahlonega, Auraria, Proserpine, Danæ, High Tower, and Palmour. The veins lie generally parallel and have a strike about northeast and southwest. The Etowah River crosses some of them in a serpentine manner.

The mines in the immediate vicinity of Dahlonega lie on Findley ridge. Considerable work has been done on the west of this ridge, and piping over both sides. There is no dump for extensive workings, nor would the farmers long permit it if there were. Water could be brought to the top of the ridge, but only at great cost. Passing along the top of the range from which the water is drawn for hydraulicing, I found the Columbia reservoir 260 feet above the mill. The water is forced up through a five-inch pipe by a steam engine, 100 feet or more. The cost of pumping this water is said to be $4 per day, but I thought this a low estimate. The auriferous matter in the opening is stratified and dipping. It is schistose with small veins of quartz, and lies on a bedrock of gneiss. The Findley mine, from which the ridge takes its name, was the first discovered. It is not now worked. Water from the supply ditch is sold at 10 cents per 24 hours miner's inch. A United States Branch Mint, established at Dahlonega by Act of Congress March 3, 1835, commenced coining in 1838, from which time until closed, during the civil war, it coined 1,381,784 gold pieces, valued at $6,121,916. In July, 1871, the buildings and grounds were transferred to the State of Georgia, and became the North Georgia Agricultural College, with imposing buildings and prominent position.

The Barton and Hand mine lies three miles southwest of Dahlonega. An attempt to "dry mine" resulted in failure. The fine forty-stamp mill was erected in 1882. The company use 150 to 200 inches of water from a ditch owned by themselves. One hundred and fifty tons per day are crushed. All the stamps are driven by one cam shaft, which extends through the mill. Mr. John Huff, the Superintendent, showed me through the works and mill. Here I saw a three-inch hydraulic nozzle, the largest I had met with in Georgia. Water is pumped up by steam for piping. It was found here that the yield of gold was proportional to the distance of the mill from the cuts, owing no doubt to greater disintegration in the sluices.

The Bast and Ivey Consolidated is about a mile southeast of Dahlonega, in the Findley belt. The mill has 20 stamps. Water is pumped up to a reservoir, 100 feet above the cuts, with a capacity of 130,000 gallons, from which it is brought down in ten-inch pipes to a nozzle of two inches. The auriferous matter has been experimentally treated in pans, but with what success I did not learn. The gold is contained mostly in thin quartz veins in soft mica schist.

The Columbia Mine lies on Findley Ridge, near Dahlonega. The mill has 20 stamps, run by water; a ten-inch pipe supplies a turbine wheel. Water for piping is forced up to a reservoir by steam power. Cost of wood, $2 per cord; common labor, 90 cents per day; engineer, $1 per day. The Columbia Mill is 100 feet below the hotel at Dahlonega. The quartz veins in the cuts are narrow and not continuous. The schists are highly

ferruginous, and there is a large quantity of brickbat to be removed with the auriferous matter. The workings are about 100 feet long by about 50 feet wide and 25 or 30 feet deep. There is no hard bedrock, but at a certain distance below the surface there is a soft rock, which, however, could be picked or blasted and piped off without difficulty. The small pressure box is 250 feet above the mill, but only about 100 feet above the cuts. The mill is generally cleaned up once a week, and Saturday is the day selected for that purpose.

The Lockhart Mine is on Findley belt. The ore deposit or vein is from 6 to 10 feet wide. It is worked in two mills, of 5 and 10 stamps.

Auraria, with its group of mines and mills, lies six miles southwest from Dahlonega. At and near Auraria there were the following mills in 1881:

Chicago and Georgia	10 stamps.
Auraria	10 stamps.
Wells	10 stamps.
Cleveland	10 stamps.
High Tower	10 stamps.
Bell	10 stamps.
Total	60 stamps.

Yield of gold near Auraria, 1881, $8,000; in 1883, $10,000 (estimated).

The Fish Trap is one and a quarter miles from Dahlonega. It has what is considered an ore channel 75 feet wide. The yield from the 20-stamp mill is fair but the mine is not continuously worked.

At the Gordon Mine I met John W. Weaver, Superintendent, who gave me much valuable information as to the general character of the mine, manner of working, yield, etc., and some characteristic specimens, which have been placed in the State Museum. At the mill 20 stamps only were running, but 30 more were being put in place. The 20 stamps crush 60 tons of stuff in a day, yet they weigh only 450 pounds each. The ore bins at the end of the sluices and near the mill are very well and conveniently arranged. They have a capacity equal to the floor space in the mill behind the batteries. The sluicing is continued until sufficient material has collected in the bins for a run, when it is boomed into the mill as usual.

The Ivey Mine is on Pigeon Roost belt, more than one and a half miles southwest of Dahlonega. Water is supplied from the Hand Ditch. At the new mill there were 60 stamps running. The mill is driven by water under a pressure from a 180-foot head. A steam engine is supplied for use in the event of a short supply of water or an accident to the pipes or wheel. The Bast belongs to the Georgia Consolidated Mining Company. The yield of gold for the year ending June 1, 1883, was as follows:

Ivey	$38,289 64
Bast	22,482 11
Total	$60,771 75

The Pigeon Roost Mine is in the Pigeon Roost belt. There is a small mill of ten stamps. The cut is about 250 yards from the river. There was not ore enough, at my visit in May, to keep the mill running continuously. In the river at this point there were formerly very rich placers. Some large nuggets have been taken out.

There is another interesting gold field that I visited and studied, which is on the same auriferous belt but further north. The largest adjacent

town is Blairsville, which is the county town of Union County. It has been mentioned elsewhere, and the country about it described. The Gum Log Mine, or deposit, lies in a small hill, the body of which is soft shale, rich in gold, which comes no doubt from the multitude of thin quartz veins which intersect the hill. On the creek near by stands an old mill with partly decayed overshot wheel, in which the auriferous quartz was worked for gold, years and years ago. Still no consecutive work has been done beyond coyoteing and the making of some small open cuts, yet from the prospects I made I am convinced that with judicious working the whole hill could be made to pay.

Judge Wellborn, of Blairsville, informed me that when he was a boy the old Gum Log was worked by a company. He was sent with 1,900 pennyweights of gold to mint at Dahlonega. This was taken out by hand-beating. They then put up a trough, in which four stamps dropped. There were no screens or plates. The water slopped over, and but little gold was saved. A man came along and obtained permission to work the tailings, and he obtained 1,000 pennyweights of gold.

Wellborn Hill, a mile or so from the Gum Log, is also a very promising locality. The mine is fairly well opened, and there is a good mill ready for operation when the water is turned into the ditch, which is also nearly ready for working. I saw no reason why the mill should not be started up and the quartz crushed with success. The mill has ten stamps, with space and ample power for ten more. A projected tunnel, the entrance of which is near the mill, will cut the vein at a considerable depth, and can be made an outlet from the mine for years to come. When all the upper works are exhausted, lower levels could be pumped through the tunnel by water power. I prospected the quartz, and found some of it rich in gold.

I think quartz could be gathered on the surface of the ground over a large area of country, which would pay in the mill. Labor can be obtained for $10 per month or 50 cents per day, and found. Board costs $1 50 per week. The mine was discovered about twelve years ago by Edward D. Rodgers. He used to pay 40 cents per bushel for crushing the ore to sand in stump mortars, with stamp pestles made by setting iron wedges in stems of wood, which, for convenience, were attached to spring poles. He then rocked the sand with quicksilver. The gold obtained gave him a profit of about $1 per bushel. The stump mortars may still be seen. The tree was cut down and the stump sawed off square. The concavity was made by burning with live coals, assisted by judicious use of the ax. While this was a rude substitute for a crushing apparatus, it served a useful purpose, and enabled the miners, in an imperfect manner, to extract the gold that under other conditions would have been practically inaccessible. There has at no time been a mill at this mine. The new mill has not yet turned a wheel.

On my return to San Francisco a sample of quartz from Wellborn Hill, weighing 320 grams, was crushed and sifted, and at my request Mr. Melville Attwood carefully washed it in a batea. The prospect, or residue, weighed 0.1263 grams. It contained a little quartz, but was largely gold, beautifully clean and bright, and part of it in distinct crystals. There were some particles leaf-like, but crystalline. The rock was very easily crushed. The only rock in California that I have a knowledge of, which resembles it, is at Fresno Flat, Fresno County. The prospect was all mounted on slides, and exhibited at a meeting of the San Francisco Microscopical Society.

The Nancy Brown Mine, near J. Van Brown's house, has the same general character and direction. It has been opened in several places, and

considerable work was done on it before the war. Mr. J. B. Pewitt has lived at Brasstown, just over the line in North Carolina, for twenty-eight years, and is very familiar with the country. He says that $7,000 worth of gold has been taken out of this mine. Mr. Hunt, the storekeeper, can show where $4,000 worth of gold has been expended. A small five-stamp mill with overshot wheel and rude square wooden stamps, was once placed in the mine. The old screen I saw. It was coarse and imperfect, and the wonder is that so much gold could have been saved with so rude an appliance. Two years ago Mr. Pewitt gathered five tons of float quartz from the surface of the ground that paid $10 a ton when worked after a primitive method.

The discovery of this mine was made many years ago. Mr. Pewitt found a small cropping in the road. He panned it and prospected the earth about with negative results. A woman told him she had panned gold from a spring near by. He examined the spring and found gold. In four days he took out $163 worth of gold from float rock, after which he found the Nancy Brown vein. No work has lately been done upon this property.

The Old Field Mine near by was discovered since the war. Many years ago in the branch below, Mr. Kinsey ground-sluiced the lower end of the vein as a placer mine, and with slave labor extracted $1,200 worth of gold. In seeking the source of the gold the ledge was found. The ore is considered low grade, but it has the same general appearance as the other. The vein has also the same general course. It has not been worked to any great extent, and now lies idle.

There are several promising mines near Blairsville. Judge Wellborn showed them to me and gave me much information concerning them. They are wholly undeveloped. The Alice Mine was prospected by a small open cut, several years ago. There are two small veins exposed, which seem to be well defined, and show large croppings at the surface. The ore and the mine seem promising, and they should be more thoroughly explored. The gold miners in Georgia seem to be timid. They make their explorations too cautiously. I saw mines that in California would be considered worthy of sinking on for several hundred feet, prospected only to a depth of from five to fifteen feet. In all my tour through the gold mines, I saw no hoisting works, not even a whim. Some day the prospecting will be conducted on a larger scale, and perhaps with better results.

Gold mines of considerable promise are found in Nacoochee Valley, White County. I did not visit them, but was furnished with the following note by Gorham Blake, an old Californian, who is interested in the district:

LOUDSVILLE, WHITE COUNTY, GEORGIA, May 28, 1885.

In White County, Georgia, gold was discovered early, when the ground was occupied by the Cherokee Indians. Many nuggets were found in Nacoochee Valley, and within two years a Mr. Lumsden found several thousand dollars in nuggets in his garden, ranging in value from $5 to $400. There are several gold-bearing quartz veins near this beautiful valley. A twenty-stamp mill is now just completed for Mr. Childs, a banker in Georgia. Also, prominent for over forty years, has been the old "Sprague" and "Lewis" gold mines, now owned by the Forest Springs Gold Mining Company. The "Lewis" vein is ten to twelve feet in width, and yields per mill process well. Rossiter Raymond's report on tests of ore from this mine gave an average of $26 per ton. The rock contains massive sulphurets in abundance, which are rich in gold, and the vein can easily supply a twenty-stamp mill. The "Sprague" vein is from three to four feet thick, and is in places very rich. A fair mill test showed $18 13 per ton. Several other auriferous veins are on this property, which will be opened in good time. A ditch is completed five miles long, supplying abundance of water for mill power, pumps, and hydraulic purposes. Large amounts of rich gravel deposits are near the Sprague vein. It is expected these mines will show large returns when worked, as a large amount of gold has already been taken out above the water line. Labor being but seventy-five cents per day, and nature assisting so much to facilitate the working of these mines, they cannot fail to be profitable.

The old "Loud" mines are sand and gravel, and have been worked profitably for over fifty years by panning, toms, and sluices. Pockets of gold, one to the amount of seven

and three-quarter pounds of fine dust have been found. In another pocket seventeen nuggets, from the size of a pea to a pigeon's egg, were found. This property is owned by merchants in Athens, Georgia.

Gold is found in Carroll County. Judge Bonner has been working the mine since 1841. He reported to Geo. Little, State Geologist, that the average yield was $11 40 per ton from quartz, while some of the placers were rich. At Villa Rica the gold occurs in quartz and in placers. In 1855-6, 5,000 pennyweights were taken out of a stream in six weeks.

YIELD AND PRODUCTION.

The Director of the Mint thinks the average yield of gold from Georgia mines is from $1 25 to $1 50 per ton.

The total yield of gold in Georgia:

From 1829 to 1838 is estimated at	800,000 ounces.
From 1838 to 1849 is estimated at	200,000 ounces.
	1,000,000 ounces.

The sum total of gold and silver deposited from Georgia mines in United States Mints up to June 30, 1883, was as follows:

Gold	$8,043,250 51
Silver	1,524 78
	$8,044,775 29

The yield of gold for the year ending June 30, 1867, was estimated by J. Ross Browne as $28,758 20.

In 1876, Governor Smith, in a communication to the Director of the Mint, estimated the yield for the fiscal year at $150,000. In 1880, the census year, the estimate is $81,029. 1881, estimated yield, $125,000. In 1882, the estimated yield was $312,500, of which Lumpkin County produced $225,000. The Director of the Mint estimates the yield for the year 1883 at:

Gold	$199,000
Silver	1,000
	$200,000

The mint at Dahlonega coined gold from the commencement to February 28, 1861, to the value of $6,115,929.

The gold fields of Georgia will yield the precious metal for years to come, if the miners are allowed to work the deposits.

ILLINOIS.

Territory, March 9, 1809. State, December 3, 1818. Area, 55,410 square miles. Population in 1880, 3,077,871. Capital, Springfield. Floor space in Exposition, 6,750 square feet.

The State is divided into 102 counties. Next to Delaware and Louisiana, it is the most level State in the Union. In the northwest corner of the State, near Galena, there are some low hills.

Illinois is essentially an agricultural State, but the mineral productions are also important.

It is well supplied with coal, in fact it has been asserted that the whole State is a vast coal field. The area of the beds is estimated at 30,000 square miles.

Some of the veins are from six to eight feet thick. More than 2,000,000

tons of coal are annually mined in the State. The iron ores found in the coal measures are considered of but little value. Salt is made from saline springs.

Lead is found in very large quantities at Galena, in Jo Daviess County, and in small quantities in the southern part of the State.

At the Exposition, the mineral display was not large. One case contained specimens collected by the State Geological Survey which was very interesting. The most noticeable minerals and mineral products were galena in very large and very perfect cubes, bars of pig lead from the same ore, a pedestal of onyx marble, potters clay, a fine series of building stones, pottery, including sewer pipes, terra cotta, brick, ornamental tiles, coal from various localities, etc.

INDIANA.

Territory, July 4, 1800. State, December 11, 1816. Area, 33,809 square miles. Population in 1880, 1,978,301. Capital, Indianapolis. Floor space at Exposition, 6,800 feet. State divided into 92 counties. The collective exhibit from Indiana was not made officially by the State, but by private individuals.

Indiana has no mountain land. Two thirds of the surface is nearly level. Marbles and limestone are found in quantity. The most valuable mineral mined is coal, which occurs in great abundance.

The following is an extract from a handbook published for the Exposition:

THE GREAT COAL FIELDS.

The Indiana coal fields embrace an area of over 7,000 square miles, offering seven workable seams at a depth ranging from 50 to 220 feet, and averaging 80 feet below the surface. The seams vary in thickness from 2½ to 11 feet, averaging 4½ feet. The quality is fair to good, as shown by analysis in the Geological Reports. An area of 600 square miles in this field yields a superior block or "splint" coal, which is used in the blast furnace as it comes from the mine without coking. Our block coal is rich in carbon, and remarkably free from sulphur and phosphorus, and well adapted to the preparation of Bessemer steel, etc. The abundance of coal and ease of access cheapen this fuel. It may be had on every line of railway, from 5 to 10 cents per bushel, or at $1 50 to $2 80 per ton.

Near the coal fields there are available beds of iron ores.

The mineral exhibit made by Indiana was not large. To me the most interesting feature was the magnificent terra cotta work—tiles, fire-brick, and other products of clay. This special exhibit consisted of drain pipes, tiles, earthenware, pressed brick, encaustic tiles, very fine and in great variety of design and color, some beautifully painted by the pupils of St. John's Academy, Indianapolis—several highly ornamental pediments of red terra cotta—and beautiful designs of various natural objects in the same material were finely shown. The clay was from Dubois County.

There were also large blocks of coal and some geodes, a few of which were broken to show the internal crystallization, but they were not fine.

The State abounds in building stones. One magnificent block of sculptured Indiana oolitic limestone was shown and greatly admired. The following description of this stone is from the handbook mentioned before:

THE BEST BUILDING STONE IN THE WORLD.

The State abounds in the finest building stone in the world. By far the most beautiful and valuable stone for architectural purposes is the Indiana oolitic limestone. The supply is simply inexhaustible, as it lies in massive strata of from 20 to 70 feet thick, over an area of more than fifty square miles. These strata are homogenous, equally strong in vertical, diagonal, or horizontal sections. The stone comes from the quarry so soft as to be readily worked by saw, chisel, or planing machine, while on exposure it hardens to a strength of from 10,000 to 12,000 pounds to the square inch—a strength amply sufficient to

sustain the weight of the largest structure in the world. In use it presents a handsome, creamy brown appearance, gradually whitening with age. It is of almost unprecedented purity, containing an average of 96.8 per cent of carbonate of lime, a purity rarely, if ever, surpassed, and scarcely equaled in the world. Hence its advantage over the magnesian limestones, as it is not affected by decay in an atmosphere charged with the gases of burning stone coal. In natural outcrop it presents bold perpendicular faces to the elements, showing every scratch and mark, unaffected after the exposure of thousands of years, unlike any other stone or rock. It is quarried in prisms six by ten, 50 or 100 feet long, putting to shame the boasted prodigies of Egyptian story and effort. It is then rapidly sawed into blocks and dimension forms, and steam planers carve, mold, and smooth it like clay or wood, and more accurately than mallet and chisel. It is now fit to be carved and polished into the finest kind of sculptured and ornamental work.

Ready for the mason or sculptor, it is alive and resonant, answering with a clear metallic ring each touch or blow. This resonance is an excellent test of the perfect unity of its particles, and as a result it is highly elastic, bending under pressure and rebounding to place when relieved from it. This elasticity enables Indiana oolitic limestone to adapt itself without cleavage or disintegration to changeable climates, where material will be frequently subject to a change of from 20° to 60° of temperature in a few hours; as in large buildings the outside will be subject to a temperature of 25° below zero in Winter, or 120° above it in Summer, while the inside will remain at 60° or 70°—differences of 50° to 80° in the extremities of the same stone—with their accompanying effects in expansion or contraction. The strains of heat and frost will tear down buildings and sides of mountains with their great expansive forces, and even steel and iron will give way before them. Here, then, is presented to the builder and architect a new and wonderous element in an "elastic stone," a potent quality which, united with its other sterling excellencies of strength and beauty, makes Indiana oolitic limestone the best in the world for exposed work in buildings in localities subject to great climatic changes. It has been and is now being used in many of the finest public structures in the country. The new $2,000,000 Court House at Indianapolis, the new State House, the Post Office, and many churches in that city, the Custom House at Louisville, the City Hall and the water tables of Lincoln Park in Chicago, many fine structures in St. Louis, the Cotton Exchange in New Orleans, and many public and private buildings in New York and Philadelphia, and the exposed parts of the new State House of Illinois, are built of this stone.

While Indiana cannot be classed among the gold-producing States, it is interesting to know that $40 13 in gold of State production is recorded in the reports of the United States Mint as having been deposited in that institution.

IOWA.

Created a Territory July 3, 1838. Admitted to the Union March 3, 1845. Area, 55,045 square miles. Population in 1880, 1,624,615. Capital, Des Moines. Floor space in Exposition, 10,175 square feet. The State is divided into 99 counties. The surface is generally undulating, but there are no mountains or high hills. The principal minerals of the State are coal, lead, gypsum, and building stones. The area of the coal fields of the State is estimated at 20,000 square miles. The coal is bituminous and of excellent quality. Lead is produced in very large quantities near Dubuque. The iron found in the State is in small quantities, and its exploitation has not as yet become important. The following extracts bearing on the mineral resources of Iowa are taken from a pamphlet entitled:

IOWA—NOTES ON THE GEOLOGICAL FORMATIONS, BY S. CALVIN, SUPERINTENDENT GEOLOGICAL DEPARTMENT, WORLD'S EXPOSITION AT NEW ORLEANS.

The galena limestone is a coarse, vesicular, heavy-bedded, buff-colored, magnesian limestone that lies directly on the Trenton. It occurs in the upper portions of the bluffs for some distance above Dubuque, while just at Dubuque it makes up the entire bluff from base to summit. Rich deposits of lead ore—*Galenite*—occur in the caves and crevices of the galena limestone. The galena limestone affords excellent material for heavy masonry; and the *Dubuque lime*, that has long been known with so much favor throughout counties farther west, is manufactured from this formation.

The coal measures occupy a large area in central, southern, and southwestern Iowa. They constitute one of the most important geological formations, their chief claim to consideration resting on the inexhaustible stores of coal that are included at different heights between the rocky layers. The coal product of Iowa will be discussed by Captain Head, so that it remains for me only to say that the coal measures, in common with the

other geological formations, furnish in many localities most desirable stone for building purposes. Limestones prevail in the upper part of the carboniferous series, and are utilized extensively in Madison, Montgomery, Taylor, Page, and other southwestern counties. The upper coal measure limestones furnish beautiful series of fossils, illustrating the animal life of the carboniferous seas, while the delicate ferns and curiously sculptured trees, whose remains occur associated with the beds of coal, throw light upon the character of terrestrial vegetation during the coal period.

Overlying the coal in Webster County are immense beds of white and gray gypsum that are already beginning to take rank as deposits of great commercial importance. These beds furnish material for the manufacture of plaster of Paris. The rock itself, soft and easily cut into desired shapes, is used as building stone, while the *Cardiff Giant* is one of the well known products of these interesting deposits.

The following information was obtained from Mr. E. H. Calkins, of Burlington: The Legislature made no appropriation. $5,000 was received from the State allotment. The cost of the exhibit is estimated at from $15,000 to $16,000. The several counties were assessed, and the next Legislature will be asked to pass a bill to meet the deficiency. Should that body fail or decline to do so, the counties will be compelled to meet the expenses. Professor S. Calvin, of the Iowa State University, deserves special credit for the geological exhibit, arranged by him and under his special care.

The mineral exhibit from this State was not large, but was specially fine and important. It was well selected, and every specimen would be considered a gem in any collection. The fossils were devonian, upper silurian, and carboniferous. The whole collection was contained in six, not large, vertical cases. Many of the corals were shown also in polished slabs. I noticed a neat way of labeling, by tacking the card to a movable block laid in the paper trays, being of the same rise as the paper edge, which brings the label up to the level of the edge. The card was fastened by small round-topped nails. The minerals shown were few, but exceptionally fine, and there were no duplicates. Among them the following were the most noticeable: blende; calamine; calcite; copper, native, a single erratic block brought to the State during the drift period; galena, in large masses and crystals; gypsum-selenite, the curved variety, very fine.

Rocks, etc., were represented by a small but fine collection of lithological specimens and photographs of quarries, and soils in glass prisms, showing the thickness.

KANSAS.

Territory, May 30, 1854. State, June 29, 1861. Area, 81,318 square miles. Population in 1880, 996,096. Capital, Topeka. Floor space occupied at Exposition, 10,175 square feet. State divided into 104 counties. The surface is an undulating plateau, the elevation of which is from 750 to 3,500 feet above sea level. The principal mineral productions of the State are coal, salt, gypsum, building stones, clay, lime, etc.

The coal measures underlie the eastern portion of the State, with an estimated area of 17,000 square miles. The veins of coal vary from very thin seams to others seven feet in thickness. There are five distinct workable beds or veins. The Cherokee coal averages three and one half feet in thickness. Coal is extensively mined in Cherokee and Crawford Counties. The fuel is good quality, cokes well, and is comparatively free from sulphur and phosphorus.

Salt is found in beds from six to twenty-eight inches thick. It is crystalline and of good quality. It is also made from brines.

Gypsum occurs over an area of many square miles, and is manufactured extensively into plaster of Paris and land plaster in large mills.

Building stones of dolomite and limestone abound.

The miocene formation of the cretaceous strata, which extends over a large

area of the State, contains chalk. At Wakeeney, Trego County, works have been established for the manufacture of whiting. This is the only known locality of chalk in America.

Iron ores are found, but are not yet smelted.

Petroleum has been found, but has not as yet become important.

The exhibit at the Exposition was made officially by the State. Although Kansas made one of the best collective exhibits in the Government Building, the mineral resources were but poorly represented. Among the few minerals shown the following were the most interesting and important: blende, crystallized in large slabs; calamine, very fine; galena, in large cubes, very fine specimens; pyrites, cockscomb variety, one splendid mass of several hundred pounds in weight; smithsonite, ores of zinc, lead ores, and zinc bars manufactured at Pittsburgh; rocks and building stones, several varieties; also clay pottery, brick, etc.

The centennial vase, of a soft stone resembling volcanic ash, was presented by the ladies of Wyandotte City.

KENTUCKY.

Admitted a State June 1, 1792. Area, 37,680 square miles. Population in 1880, 1,648,690. Capital, Lexington. Floor space in Exposition, 13,100 square feet. The State is divided into 116 counties. The western part is nearly level. The southeastern portion is crossed by the Cumberland Mountains. The greatest altitude is 3,000 feet.

The mineral exhibit at the Exposition was not large but was very interesting. I regret that I cannot here describe the magnificent collective exhibit other than mineral, made by this State. In the private office of the Commissioner and officials connected with the State Geological Survey were numerous geological maps and publications and pamphlets setting forth the resources of the State, which were widely distributed.

The principal economic minerals found in Kentucky are coal and iron; of the former there were columns showing the thickness of the coal beds, and great pyramids of cannel and bituminous coal, with characteristic fossils and descriptive information of great value. Petroleum and coke were also shown.

Of ores there are but few in the State. Lead in the form of galena with blende and fluorspar occurs, but not in paying quantities.

Of rocks and building materials—oolite and shell limestones, lithographic stone, fine in appearance but defective, owing to fine cracks in it; sandstone, silicious conglomerates, millstone grits, etc., were shown. A large number of five-inch cubes and a number of one-foot cubes, and still others in irregular masses, were also shown. A sample of fire-clay, said to be of excellent quality, but more resembling lithomarge than fire-clay, and potters clay called "Indianaite," were on exhibition; also bricks, glass sand, and building materials.

Of minerals there were shown fine specimens of galena, calcite, fluorspar, etc.

While the mineral display at the Exposition was so small it was interesting to be informed that the Museum of Natural History of Kentucky contains more than 40,000 specimens, and the museum attached to the Public Library has over 100,000 specimens, a large proportion of which are from the mineral kingdom.

I had the pleasure of meeting Mr. W. M. Linney, of the State Geological Survey, from whom I obtained publications and much valuable informa-

tion. A system of exchange was planned for the future, which will, I trust, be to the advantage both of California and Kentucky.

LOUISIANA.

State, April 30, 1812. Area, 41,346 square miles. Population in 1880, 934,946. Capital, Baton Rouge. Floor space at Exposition, 9,805 square feet. Louisiana is divided into 57 parishes, equivalent to counties. The surface of the State is generally low and level. The highest land is only 200 feet above the sea level. The known mineral resources are but small, and did not make a very large showing, although of considerable interest.

The following general description of the State, the City of New Orleans, the attractions and accommodations offered visitors to the Exposition, and account of the mineral exhibit, is compiled from the *Times-Democrat Almanac*, 1885, certain handbooks, and the newspapers:

GOVERNORS OF LOUISIANA—*Under French Rule.*

Sauvolle	1699
Bienville	1701
Lamothe Cadillac	1713
De L'Epinay	1716
Bienville	1718
Boisbriant, *ad interim*	1724
Perier	1725
Bienville	1732
Marquis de Vaudreuil	1742
Kerlerec	1753
D'Abbadie	1763

Under Spanish Rule.

Antonio de Ulloa	1767
Alexander O'Reilly	1769
Luis de Unzaga	1770
Bernardo de Galvez	1777
Estevan Miro	1784
Francisco Louis Hector, Baron de Carondelet	1787
Gayoso de Lemos	1792
Sebastian de Caso Calvo y O'Farril, Marquis de Caso Calvo	1799
Juan Manuel de Salcedo	1801

As a Part of the United States.

W. C. C. Claiborne, Territory of Orleans	1804
W. C. C. Claiborne, State of Louisiana	1812
Jacques Villere	1816
Thomas B. Robertson	1820
Henry Johnson	1824
Pierre Derbigny	1828
A. Beauvais (acting)	1829
Jacques Dupre (acting)	1830
Andre B. Roman	1831
E. D. White	1835
Andre B. Roman	1839
Alexandre Mouton	1843
Isaac Johnson	1846
Joseph Walker	1849
Paul O. Hebert	1853
Robert C. Wickliffe	1856
Thomas O. Moore	1860
Henry W. Allen, Governor under the Confederate Government	1864
Michael Hahn, Governor under the Federal Government	1864
J. Madison Wells (acting)	1864
J. Madison Wells	1865
Joshua Baker, appointed by the military authorities	1867
B. F. Flanders, appointed by the military authorities	1867
H. C. Warmouth	1868

John McEnery, Governor *de jure*	1872
W. P. Kellogg, Governor *de facto*	1872
Francis T. Nicholls	1877
Louis Alfred Wiltz	1880
S. D. McEnery	1881

THE CITY OF NEW ORLEANS—HISTORICAL AND DESCRIPTIVE.

The City of New Orleans was founded in 1718 by Bienville, the Governor from the French settlement of Biloxi, Mississippi, who sailed over from that place with his followers, landing at the Spanish Fort, on Lake Pontchartrain, four miles from the city; finally moved over to the river shore and started a settlement, in the locality of the French Market. He gave the settlement the name of New Orleans in honor of the reigning family of France.

New Orleans grew very slowly under French domination and had only attained a population of 3,000 inhabitants in 1769, when it (included in the Colony of Louisiana) was ceded to Spain. Some better progress was made under the Spanish rule by reason of the opening of trade relations with the Western and Northwestern States and Territories, immediately after the close of the Revolutionary War, so that in 1801, when the colony was ceded back to France, New Orleans contained about 8,000 inhabitants. In 1803 it was ceded by France to the United States. It then had a population of 10,000. In 1810 it had a population of 22,000. In 1830, 46,000. In 1840, 102,000. In 1850, 116,000. In 1860, 169,000. In 1870, 191,000. In 1880, 216,000. At this time about 240,000.

City Government.

New Orleans—Incorporated 1804. Reorganized in 1852, 1870, and 1882. Municipal election in April of every fourth year.

Mayor—J. V. Guillotte.

Treasurer—I. W. Patton.

Commissioner of Public Works—John Fitzpatrick.

Comptroller—J. N. Hardy.

Commissioner of Police and Public Buildings—Pat. Mealy.

City Attorney—Walter H. Rogers.

City Surveyor—D. M. Brosnan.

The City of New Orleans is situated in the alluvial portion of Louisiana, which at one time formed a portion of the bed of the Gulf of Mexico. It is located principally upon the east or left bank of the Mississippi River, about 106 miles from its mouth at the Jetties (South Pass). The city extends a distance of ten miles along the left bank of the river, with a width of settlement from a half mile to three miles.

The natural surface of the city is very nearly a level, with the drainage from the river back to the swamp and canals in the rear, and from thence to the lake. Lake Pontchartrain, four miles immediately north of the city. It is a body of salt water, having direct tidal connection with the Gulf of Mexico.

The Mississippi River enters the corporate limits of the city from the west, then turns sharply to the south, then to the east, then to the north (forming a crescent, from which the city receives its popular designation of the Crescent City), and finally turns and leaves the city in a southeastern course.

On the west or right bank, the suburbs of Algiers and Gretna are situated. Constant communication is kept up by means of steam ferries. The wharves of the city extend for many miles up and down both banks. Shipping of the deepest draft lie readily at the wharves. The channel of the river opposite the city shows depths running from 150 to 200 feet. The banks of the river are higher than the larger portion of the surface of the city.

The drainage of the city is surface or open drainage, and cellars or underground improvements for occupancy are not practicable. The principal business streets are paved with the large granite blocks. Some streets are paved with cobblestones, and St. Charles Avenue, from Lee Circle to Napoleon Avenue, has the asphaltum pavement.

The Street Railway System.

The City of New Orleans is favorably situated for street railways, and has an admirable system of them. Canal Street, a wide and beautiful thoroughfare, runs directly back from the river in a northwesterly direction, nearly equally dividing the city—especially dividing the old, or French portion (lower) from the new, or American portion (upper). Nearly all of the street car systems center on Canal Street. From that street nearly every portion of the city can be readily and promptly reached by them. There are six distinct street car companies, and twenty-four different lines. The rate of fare is invariably five cents.

Streets.

Streets run parallel with the river and at right angles with it. As the course of the river is that of circles it follows that streets run in all directions. Down town and business streets are generally quite narrow—from thirty to sixty feet wide. Many of the residence streets, like Esplanade, Claiborne, and Rampart in lower town, and St. Charles, Louisiana, and Napoleon Avenues and Jackson Street in upper town, are wide and capacious.

Streets change their names on crossing Canal Street.

Street Numbers.

Numbers run back on streets each way from Canal Street, and from the river back on all cross streets. Owing to irregularity in the size of squares the system of numbering is imperfect. Numbers run one to the lot, which in frontage vary from twenty-nine to thirty feet, and lots average about twelve to the block. On parallel streets the even numbers are on the river side, and on cross streets on the upper side.

Points of Interest.

A city of the age, historical associations, and cosmopolitan population of New Orleans cannot fail to present many points of interest. The St. Louis Cathedral (built in 1724) and the ancient Court Buildings on either side, the trio overlooking Jackson Square, are very interesting to the visitor.

Likewise the celebrated French Market (the most extensive and complete in the world) a couple of blocks further down the river. And still a couple of blocks beyond the market is the United States Mint, always an attractive object to visit.

The Granite Custom House, foot of Canal Street, the United States Barracks down on Lower Levee, and Chalmette Cemetery (United States) on the famous battle grounds of eighth of January, 1815, are places of deep interest to every stranger.

The different cemeteries, especially Metairie, Greenwood, and Washington, afford unique and interesting experiences to the stranger. A visit to the long line of wharves and to the multitude of shipping from all parts of the world, furnish a most interesting and valuable experience.

A visit to some of the cotton compresses in the city, of which there are a large number, would interest any one not familiar with the huge and powerful machinery used. Likewise would a visit to the sugar refineries.

The lower or French town, with its peculiar, quaint-tiled roofed structures, and flower-embowered courtyards, and Latin-tongued inhabitants, presents to the antiquarian and student constant surprises.

The cemeteries, or, as they may be appropriately termed, the sepulchers of the dead, afford such a contrast to those of other cities and sections that they prove attractive objects for visiting and investigation. The system of intra-mural burial, necessitated by the hydrographic condition of the soil, is peculiar to New Orleans. Metairie, Greenwood, and Washington Cemeteries are well worth visiting.

There are numerous parks well worth visiting; and several noted monuments and statues. Jackson's in Jackson Square; Franklin's in Lafayette Square; Lee's in Lee Circle; Clay's on Canal Street; Margaret's at Margaret Place—all will afford interesting study.

There are about 150 miles of street car lines in the city. A trip over every line will, in the experience secured, and in the different phases of life observed, repay the visitor for the time taken.

Suburban Resorts.

Notwithstanding the physical situation of New Orleans, surrounded as it is with cypress or open swamps, it possesses several very attractive suburban resorts. The oldest and formerly most widely celebrated is Milneburg, on the south shore of Lake Pontchartrain. It is reached by the old Pontchartrain Railroad, the first railroad actually finished in the New World, built in 1831. It is also reached by a shell drive or road. It possesses fine bathing facilities and first-class restaurants. From its wharves, during the Spring and Summer seasons, steamers run regularly to the resorts on the north shore of the lake—Mandeville, Lewisburg, Madisonville, Covington, and Abita Springs. Spanish Fort, a mile further to the west, has grown up to be a resort of unusual interest and magnificence. It has large, beautiful, and elaborate gardens, commodious hotels and restaurants, an immense hall, and a splendid theater and opera house. Trains reach it regularly on the Spanish Fort Railroad, leaving Basin at Canal Street. Fare fifteen cents round trip.

New Lake End, two miles still further west on the lake shore, has manifold attractions as well as the amplest accommodations as a suburban resort. It has a first-class hotel, kept in the best style, a large theater or opera house, and innumerable other accommodations. Facilities for bathing, rowing, sailing, and fishing are unrivaled here. Out of Bayou St. John steam and sailing craft in large numbers cover the lake and tributaries. The New Lake End Railroad, starting on Canal, between Carondelet and Baronne Streets, run regular trains. Fare fifteen cents round trip.

Tchoupitoulas line, green cars, green lights, starts every three minutes from Canal, near Camp, goes up Tchoupitoulas to the grounds, landing at entrance near Mexican National Headquarters Building. Fare five cents.

The time by street cars from Canal Street to the Exposition grounds is from thirty-five to fifty minutes.

Excursions by Land and Water.

The opportunities for interesting and instructive excursions are innumerable. On the Shell Beach Railroad, eighteen miles to old Proctorville and Lake Borgne; on the Louisville and Nashville (at one cent a mile excursion rates), to the famous watering places along Mississippi Sound; by the same route to Mobile and all points in Florida; by Morgan's Louisiana Railroad to the beautiful country of the Teche, the scene of Longfellow's popular Acadian romance and poem of Evangeline; by the same route to the remarkable

salt deposits of Petit Anse, 140 miles from the city; by this same route you cover Texas and Mexico.

By water you can go to nearly every point of the compass. Constant excursions run to the jetties, giving admirable opportunities of viewing famous sugar plantations and orange groves. Magnificent boats are constantly leaving the city, traversing the upper rivers and bayous, making short and long trips, nearly all having special excursion rates. By steamer you can reach all of the leading Gulf ports—Mexico, Belize, Honduras, Panama, the Bay Islands, Jamaica, Cuba, and the Florida ports.

Places of Amusement.

No city of its size has a greater *penchant* for diversion and amusement, nor goes to a greater expense for its gratification than New Orleans. Its inhabitants are indeed a pleasure-loving, a pleasure-seeking, and a pleasure-experiencing people. It enters into their business calculations and arrangements. Hence, opportunities are abundant, the supply keeping pace with the demand.

The famous French Theater de L'Opera, Bourbon and Toulouse, evidences the high taste and former extravagance of the people. It was built expressly for high or grand opera. A French grand opera troupe is now organizing in Paris to come over and give a season.

The Grand Opera House on Canal, the Academy of Music, and the St. Charles Theater on St. Charles Street, between Poydras and Perdido Streets, are the three legitimate theatrical resorts of the city. Legitimate dramas, grand and bouffe operas only occupy their boards. These theaters are under the able and experienced management of Mr. David Bidwell, one of the most sagacious theatrical managers of the country. Mr. Bidwell is the proprietor of the last two mentioned theaters. His influence and relations with the profession are such that he can always secure the best attractions, and New Orleans is constantly indebted to him for opportunities of theatrical enjoyment and experience equal to those of the first cities of this country.

As evidence of the character of entertainment afforded by Mr. Bidwell, the attractions presented by him at this writing (January 28) are as follows: Her Majesty's grand opera troupe (Mapleson's), among the members of which are Patti, Mlle. Nevada, etc., at the St. Charles, John T. Raymond (Col. Mulberry Sellers) at the Academy, and Aimee in French opera bouffe at the Grand Opera House.

Grunewald Opera House, foot of Baronne, presents attractions of a high class in drama, opera, and concert.

TULANE UNIVERSITY.

Administrators.

Senator Randall Gibson, President.
Chas. E. Fenner, First Vice-President.
James McConnell, Second Vice-President.
P. N. Strong, Secretary and Treasurer.
Dr. T. G. Richardson.
Edgar H. Farrar.
Cartwright Eustis.
R. M. Walmsley.
W. F. Halsey.
Ed. D. White.
Rev. B. M. Palmer.
Henry Ginder.
Governor McEnery.
Warren Easton.
Samuel H. Kennedy.
W. R. Stauffer.
J. T. Hardie.
Mayor Guillotte.

Professors.

Wm. Preston Johnston, President.
R. H. Jesse, Latin.
J. L. Cross, Mathematics.
Robert Sharp, Ph.D., English and Greek.
Brown Ayres, Physics, Chemistry, and Astronomy.
J. H. Deiler, German.
L. C. Reed, Principal of High School.
J. R. Ficklin, Vice-Principal of High School.
Alcee Fortier, French.
J. Armstrong, Latin and Mathematics.
A. S. Wheeler, Assistant Professor of Mathematics and Physics.
Walker Fearn, Spanish and Italian.
Geo. Gessner, Assistant Professor of Greek.
J. M. Ordway, Applied Chemistry and Technology.
F. J. Gustine, Penmanship.

RAILROADS IN LOUISIANA.

Chicago, St. Louis, and New Orleans; from New Orleans to Cairo, Ill., 571 miles; 93 in State; owned by the Illinois Central.

Clinton and Port Hudson; from Clinton to Port Hudson, 21½ miles; all in State.

Louisiana Central; from Port Allen to Lombard, 28 miles; all in State. To be extended to Opelousas.

Louisville, New Orleans, and Texas, a part of the Huntington (Chesapeake and Ohio) system; from New Orleans to Memphis, 450 miles; 90 in State.

Louisiana Western; from Vermillionville to Orange, Texas, 112 miles; 106 in State. Controlled by the Southern Pacific.

Morgan's Louisiana and Texas; from New Orleans to Alexandria, with branches to Houma, Thibodeaux, St. Martinsville, and Avery's Salt Mine, 265 miles. Controlled by the Southern Pacific.

New Orleans and Mobile (now leased to the Louisville and Nashville); 141 miles; 33 in State.

New Orleans Pacific (controlled by the Texas Pacific); from New Orleans to Shreveport and branch to Baton Rouge, 335 miles; all in State.

Mississippi, Terre aux Bœufs, and Lake Borgne; from New Orleans to Shell Beach, 19 miles; all in State.

Natchez, Red River, and Texas (narrow gauge); 16 miles; all in State.

New Orleans and Northeastern, part of the Cincinnati, New Orleans, and Texas Pacific system; from New Orleans to Meridian, 194 miles; 42½ in State.

Vicksburg, Shreveport, and Pacific; from Delta to Shreveport, 148 miles; all in State.

West Feliciana; from Bayou Sara to Woodville, Miss. Length of road 27½ miles; 20 in State.

Texas Pacific (Shreveport branch); from Marshall, Texas, to Shreveport. Length of road in State, 17 miles.

A FEW AUTHENTIC STATEMENTS ABOUT LOUISIANA.

Louisiana has a total area of 40,790 square miles, or 26,105,600 acres. This State extends down to 28° 50′ north latitude, and its northern boundary is 31°.

By the indentures of the coast bays and coast line between the mouths of the Sabine and Pearl Rivers, it has a front on the Gulf of Mexico of about 1,000 miles.

The inland water surface—bays, lakes, bayous, and rivers—have an area of about 2,328 miles, making the land and water surface about 43,000 square miles.

The hilly lands of Louisiana	12,332,920 acres.
Level lands, about	12,773,000 acres.

These lands may be classed as follows:

Good uplands	5,248,000 acres.
Pine hills	5,497,600 acres.
Pine flats	1,585,000 acres.
Bluff lands	1,587,320 acres.
Prairie region	2,483,000 acres.
Arable alluvial	3,615,000 acres.
Wooded alluvial (swamp)	2,752,000 acres.
Coast marsh	3,338,000 acres.
Inland water surface	1,228,000 acres.
Coast bays	1,100,000 acres.

Such is the irregular shape of these land and water surfaces that it is impossible to obtain an accurate statement about any of them.

Hernando De Soto.

"In the year 1539 Hernando De Soto, one of the most illustrious companions of Pizarro in the conquest of Peru, came with a thousand men of infantry and three hundred men of cavalry to the country of the Chickasaw Indians, and encamped in their territory in Mississippi."

He had with him gentlemen of the best blood of Spain. This was but forty-seven years after the discovery of America by Columbus, 393 years ago. Gayarre, in his History of Louisiana, says:

"Now De Soto is encamped in the territory of the Chickasaws, the most ferocious of the Indian tribes. And lucky was it that De Soto was as prudent as he was brave, and slept equally prepared for the defense or the attack.

"Hark! in the dead hour of a Winter's night, when the cold wind of the north, in the month of January, A. D. 1541, was howling through the leafless trees, a simultaneous howling was heard, more hideous far than the voice of the tempest.

"The Indians rush impetuous with firebrands, and the thatched roofs which sheltered the Spaniards are soon on fire, threatening them with immediate destruction. The horses, rearing and plunging in wild affright, and breaking loose from their ligaments; the undaunted Spaniards, half naked, struggling against the devouring element and the unsparing foe: the desperate deeds of valor executed by Soto and his companions; the deep toned shouts of 'St. Jago and Spain, to the rescue;' the demon-like shrieks of the red warriors; the final overthrow of the Indians; the hot pursuit by the light of the flaming village; form a picture highly exciting to the imagination."

Father Marquette and Joliet.

"One hundred and thirty years had passed away since the apparition of Soto on the soil of Louisiana without any further attempt of the white race to penetrate into the fair region, when, on the seventh of July, 1673, a small band of Europeans and Canadians reached the Mississippi, which they had come to seek from the distant City of Quebec. That band had two leaders, Father Marquette, a monk, and Joliet, a merchant."

Robert Cavalier De La Salle.

"Seven years after the expedition of Marquette and Joliet had rolled by, Cavalier De La Salle came to the mouth of the Mississippi with forty soldiers, three monks, and the Chevalier De Tonti.

"In March, 1699, Iberville and Bienville entered the mouth of the Mississippi.

"Sauvolle was the first Governor of Louisiana. He died in 1701, and was succeeded by Bienville.

"In 1706 the French girls brought to the colony were indignant at being fed on corn bread, and threatened to leave the colony on the first opportunity. This is called the petticoat insurrection.

"Thirty-five colonists died of starvation in 1705. After an existence of nine years the French colony in Louisiana did not exceed 279 persons. Its principal wealth consisted of 50 cows, 40 calves, 4 bulls, 8 oxen, 1,400 hogs, and 2,000 hens.

"In 1724 the white population of New Orleans amounted to 1,700 souls and the black population to 3,300 souls.

"In 1727 New Orleans had no levees, and was subject to yearly overflows. It was a vast sink or sewer."

In 1735 Bienville wrote:

"One hundred thousand pounds of tobacco are made at Pointe Coupee; two women raise silkworms for amusement and succeed very well; eggs should be sent by the government to the Ursulines, who would teach the industry to the orphans, whose education is intrusted to them. The cultivation of cotton is advantageous, but the planters experience great difficulty in cleaning it from the seed. Pitch and tar are made in some abundance.

"Balize Pass, which was sixteen feet deep in 1728, in 1738 was fourteen and one half feet, and which Bienville said was filling up rapidly, is now known as Southwest Pass.

"De Vaudreuil, Governor of Louisiana in 1744, commanded the planters to have their levees made.

"In 1744 the population of New Orleans was 800 souls, not including 500 soldiers and the women and children.

"A terrible hurricane in 1746, like that of 1740, destroyed the crops of the colony and would have reduced the inhabitants nearly to starvation had it not been for boats from Illinois that annually supplied them with flour.

"In 1751 the Jesuits sent some sugar cane from Hispaniola to the Jesuits of Louisiana, and some negroes who were used to the cultivation of this plant. The experiment was abortive, and though cane continued to be cultivated successfully, it was forty-four years (1795) before the manufacture of sugar was successful.

"Sixty-four girls were sent by order of the King of France by the same vessel that brought the first sugar cane. These girls were married to such soldiers as had distinguished themselves for good conduct. And these, in consideration of their marriage, were discharged from service. Such is the humble origin of some of the most respectable and wealthy families of Louisiana.

"In 1752 Michael de la Rouvelliere made a favorable report on the agriculture of Louisiana. 'The cultivation of the wax tree,' says he, 'has succeeded admirably. Mr. Debreuil alone has made 6,000 pounds of wax. Some went to the seashore, where the wax tree grows wild, in order to use it in its natural state.' It is the only luminary used here by the inhabitants, and it is exported to other parts of America and France."

[The wax myrtle still grows in great luxuriance on the banks of the bayous in the sea marsh and in numerous places in Southern Louisiana. It produces a small berry from which the wax is made. The wax has more the consistency of the best mutton tallow than of wax.—D. D.]

"In 1755 the Acadian settlement at Grand Pré, Nova Scotia, was broken up by the English, under command of General Winslow, and the inhabitants, 1,923 persons, were taken prisoners and most of them transported to different States. Their houses and barns were burned by the English, and their property confiscated to the crown.

"In 1767 there was a considerable emigration to Louisiana from the Alibamons and Illinois districts, which had been ceded to the English, and from the Province of Acadia, or Nova Scotia. This year about 650 Acadians had arrived in New Orleans, and from that town had been sent to form settlements in Attakapas and Opelousas, under the command of Andry. In 1762 Louisiana was ceded to Spain. In 1766 Ulloa, the new Spanish Governor, arrived; also 216 Acadians arrived.

"The census was ordered by Governor Ulloa in 1766, and the whole population of Louisiana consisted of 1,903 men and 1,044 women, married and unmarried—1,375 male, and 1,240 female children; total, 5,562. The blacks were about as numerous as the whites; but the population was somewhat reduced by an epidemic, resembling in some respects yellow fever.

"O'Reilly's administration under the Spanish Government continued to 1770.

"Louisiana was ceded to the United States by Napoleon Bonaparte in 1803–4, for $9,375,000.

"Bonaparte, after the sale of Louisiana, said: 'This accession of territory strengthens forever the power of the United States; and I have just given to England a maritime rival that will sooner or later humble her pride.'

"The day may come when the cession of Louisiana to the United States shall render the Americans too powerful for the continent of Europe."

Wealth Locked Up in Louisiana Soil.

The most of Louisiana soil is rich. The pine hills and pine flats are usually considered poor, but under high cultivation the most of these lands may be made very productive. They contain most of the elements of a good soil, and only need humus and lime to make them rich.

The following is by an anonymous writer in a late New Orleans newspaper:

Some of the prairie land is poor, but most of it is rich.

The good uplands are productive.

The bluff lands are composed chiefly of fine silt, and are very productive. Some of the finest forests and noblest trees in the State are on bluff lands.

The arable alluvial lands are all rich, most of them wonderfully productive.

Wooded alluvial, or swamp lands, are all the richest lands in the State. When reclaimed and properly drained they will produce crops for centuries equal to the richest lands of the Nile. The subsoil is as rich as the surface soil to the depth of ten or fifteen feet. Underdrained, the value of this soil could not be surpassed on this continent or in the world.

The coast marsh soil is usually rich, made up of vegetable and animal matter and shells, abounding in humus and lime, two invaluable fertilizers. Posterity will convert the lands on the Louisiana coast and the swamp lands into gardens, and orchards, and meadows, and fields more beautiful than anything ever seen on this continent. Fruits and underdrains will drive malaria and mosquitoes and other annoyances from these wet regions, and health, beauty, and fertility will spring up in their places.

It can be easily demonstrated that the soil of Louisiana, in a high state of cultivation, is capable of producing the following crops:

The cotton lands—1,000,000 bales of cotton of 400 pounds each.

The sugar lands—1,500,000 hogsheads of sugar of 1,100 pounds net, or 825,000 tons of 2,000 pounds, and 2,500,000 barrels molasses, 40 gallons net.

The rice lands—3,000,000 bushels, or 1,000,000 barrels of rice, 230 pounds net.

The corn lands—100,000,000 bushels corn.

Also, 100,000,000 bushels rust proof oats, rye, barley, and other small grains; 50,000,000 bushels sweet potatoes; 20,000,000 bushels of peas and beans; 10,000,000 gallons of honey; 1,000,000 tons of hay.

Broad surfaces of meadows and pastures capable of making three to five tons of hay to the acre. Add to this 1,000,000 acres devoted to fruits—oranges, figs, strawberries, grapes, pears, apples, peaches, plums, and other fruits adapted to varieties of soil in different portions of the State.

The treasures of natural fertilizers in our vast and numerous shell banks, in our swamps, in the bottoms of our bayous, vegetable deposits ten to twenty feet deep, and our field pea, more valuable than all of the other fertilizers named.

Millions of cattle, horses, mules, swine, sheep, goats, domestic fowls, etc., can be made profitable in this State.

Numerous factories may be and will be built up in the State to work up raw materials, cotton, wool, jute, ramie, yucca filamentosa, etc., and for canning fruits and vegetables, oysters, shrimps, and other things—the oyster fields and fisheries may be made to yield $15,000,000 yearly.

Louisiana at one time since the war had but 2,045,000 acres of land in cultivation, and never cultivated 3,000,000 acres; and yet she has made in one year crops worth at the market prices nearly a hundred million dollars.

Tobacco Culture in Louisiana.

Tobacco, rice, and indigo were the principal staple productions of Louisiana a hundred years ago. In 1793 and later, in consequence of the ravages of insects upon the indigo plant, a greater impetus was given to the cultivation of tobacco.

In 1802, 2,000 hogsheads of tobacco were exported from New Orleans, and tobacco was cultivated all along the river as high up as Natchez.

About 1785, Pierre Chenet, a descendant of the Acadian French, discovered a process of curing that gave rise to the perique tobacco. The cultivation of perique tobacco is confined chiefly to the parish of St. James, about fifty miles above New Orleans. This tobacco, put up in carrottes usually weighing four pounds, but sometimes two pounds and less, is strong, rich, gummy, tough, and dark, with a shining luster.

Wheat in Southern Louisiana.

Before the country on the Ohio River was settled up and cultivated, and before the flatboats of the West brought flour, and corn, and bacon to Louisiana, the old inhabitants of Iberville parish, and other parishes, made their own wheat. It is not certain that some kind of Winter rust proof wheat would not do well now in some portions of the sugar parishes of Louisiana. It is raised in the upper parishes.

The Live Stock of Louisiana and its Productions.

The live stock on the farms of Louisiana alone, not those of towns and cities, on June 17, 1880, amounted to 651,703 head, as follows: 104,428 horses, 76,674 mules and asses, 41,729 working oxen, 146,454 milch cows, and 282,418 other cattle.

The number of swine amounted to 633,489; the number of sheep 135,631.

The Louisiana wool crop in 1881 amounted to 406,678 pounds, averaging three pounds to a sheep.

There were but 916,089 pounds of butter made on Louisiana farms in 1879, about 19 pounds to a farm (48,292 farms).

There were but 7,618 pounds of cheese made in Louisiana that year, and but 29,579 tons of hay, averaging less than one ton of hay to a farm. Most of the farmers made no hay at all, leaving the cattle to live by the principle of "root hog or die."

The Chicken and Egg Crop.

Louisiana had 1,490,907 barnyard and other fowls in 1879, and the egg crop is put down in the census at 3,392,246. If a million hens had laid but 12 eggs each in a year it would have given 12,000,000 eggs. There must have been a great many eggs stolen and not accounted for in 1879.

Sugar, Molasses, and Honey—Cotton.

Louisiana, in 1879, made 171,706 hogsheads of sugar (about 94,438 tons), 11,696,248 gallons molasses, and 400 pounds of sorghum sugar and 33,777 gallons of sorghum syrup, and 168,441 pounds of honey.

The cotton crop amounted to 864,787 bales; the rice 23,188,311 pounds.

Potatoes and other Farm Products.

The sweet potato crop of Louisiana in 1879 was 1,318,110 bushels; the Irish potato crop 180,115 bushels; the tobacco crop 55,954 pounds; 9,889,689 bushels of corn; 229.840 bushels of oats; 5,034 bushels of wheat raised in the north part of the State.

The farmers of Louisiana make their crops under very trying difficulties of numerous kinds, which we cannot now particularize.

LOUISIANA MINERALS AT THE EXPOSITION.

The exhibit of the "Pelican State" at the World's Exposition has proved a revelation to many people from abroad and some from home, regarding the varied products of the State. Sugarcane and the sugar made therefrom, cotton and Spanish moss were expected by everybody, but many features of the exhibit are totally unexpected and have called forth expressions of surprise from many visitors. Of these features perhaps the most striking is the

Mineral Exhibit.

The many people from other States who have looked upon Louisiana as being mainly an immense bank of black earth covered with the rank vegetation of tropical countries, will be surprised to learn that in that State are found coal, iron, petroleum, gypsum, sulphur, and salt. Of these the latter is the most important, and is produced in the largest quantities.

The mineral display in the Louisiana exhibit contains, in addition to the specimens of the above mentioned minerals, many specimens of interest both to the geologist and the casual spectator. The petrifactions shown are marvelous. Huge trees are turned into stone while preserving the woody fiber and bark.

The excellent mineral exhibit of Louisiana was collected and installed by Mr. Ed. Enderlee, Special Geological Commissioner, to whose skill and energy great praise is due.

Coal.

Like the deposits of iron, the coal seams of the State are almost entirely undeveloped. Yet sufficiently large quantities have been discovered to indicate that the productive coal fields of the State are far greater in area than has hitherto been supposed; a fact of much importance in connection with the development of the iron mines noted above; the coal found is of a variety known as lignite, which has been successfully used as fuel in Shreveport and other interior towns. Deposits of this coal underlie nearly the whole upland country, from the Sabine to the Ouachita River. Specimens are sent for exhibition from Bienville, De Soto, and Webster Parishes, in two of which the deposits of coal accompany those of iron.

Petroleum is found in Calcasieu Parish, about sixty miles from the coast. Large quantities of carburetted hydrogen gas pass out of the oil spring in a continuous stream, and can be used for lighting and heating purposes by merely being conducted in tubes.

Iron.

The iron of the State is found scattered in immense quantities over an extensive section of Louisiana. North of the Red River iron ore is found from Ouachita to Badian River, and from the Arkansas line it extends nearly to the Red River; south of this it appears in De Soto, Natchitoches, Rapides, and Sabine. Bienville Parish is singularly rich in iron ore, and great forests of pine and oak, necessary for furnishing charcoal, accompany the metallic deposit. Bienville Parish sends to the mineral exhibit of the State a large block of iron ore (*limonite*) weighing about two tons, together with various other mineral specimens. From Bossier Parish comes a large block of hematite, the analysis of which shows it to contain 44.85 per cent of metallic iron. Claiborne Parish shows limonite containing 52.40 per cent of metallic iron. Webster Parish sends iron ore in various forms containing 49.5 per cent metal. In the cases of hand specimens are shown several more specimens of iron ore from different parishes of the State, indicating that the range of the iron deposit is very wide.

Salt.

North of Red River, in Bienville and Bossier Parishes, there are immense quantities of saline waters and saliferous deposits, the latter being especially found in the beds of ancient lakes. In the low flat beds of these basins, which lie below the ordinary level of the country, the wells are sunk to a depth of from twelve to twenty feet, where the salt water percolates through the soil and furnishes an abundant daily supply. This is boiled in kettles, and each well furnishes from twenty to twenty-five bushels of salt per day.

In a line beginning about twenty miles west of the mouth of the Atchafalaya, on the coast of Belle Isle, and running nearly due east, are ranged five islands—Belle Isle, Cote Blanche, Week's Island, Petit Anse, and Miller's Island.

The islands rise from the low marsh and prairies by which they are surrounded, and form mounds of various sizes. The chief of them is Petit Anse (Avery's Island), which is 185 feet above the sea-tide level, and contains an immense deposit of common salt. Petit Anse is situated in Bayou Petit Anse, six miles from the north shore of Vermilion Bay, which is an arm of the Gulf. It is fifteen miles to the mouth of that bay, where there is a fine land-locked harbor of eight feet depth.

The following are the general results of the chemical analysis of Louisiana rock salt: Louisiana rock salt presents the form, appearance, and optical properties of pure chloride of sodium. The large crystalline masses are so perfectly transparent, free from all extraneous matter, and uniform in their structure and density, that they would be suitable in all respects for the most delicate philosophical experiments upon the transmission of light through different media.

The sample of Louisiana salt submitted to analysis, as well as the largest masses, weighing several tons, are of remarkable purity. This very valuable natural product of Louisiana is represented at the Exposition by large quantities of the native product as it comes from the mines; also cut and carved into various forms and sizes, and ground into table salt and packed in bags.

Sulphur is also found in Calcasieu, and in such prodigious quantities that this one deposit could supply the whole country with sulphur and with the gypsum that occurs with it. The sulphur is of unequaled thickness and purity.

These descriptions, from the very best authority, leave but little more to be said. The minerals that most attracted my attention were the following:

Four cases shown by the New Orleans Academy of Sciences, containing some fine minerals and fossils.

Of rocks and building stones but few were shown. There were some excellent bricks, common and pressed: some were curiously mottled. Some good pottery and terra cotta were also shown, and limestones from Shreveport: some newly discovered veined marble, sandstones and white sand, suitable for glass making.

Fertilizers were represented by marls, containing fossil bones and green sand marl.

There were some good gypsum and selenite from the saline basins: limonite from Webster and other parishes, and salt, in a large pyramid, from Iberia, also among the mineral exhibits.

MAINE.

Admitted a State, March 15, 1820. Area, 31,674 square miles—another estimate, 35,000 square miles. Population in 1880, 648,936. Capital, Augusta. Floor space at Exposition, 4,417 square feet. The State is divided into 16 counties. The surface is generally hilly and mountainous. The highest point, Mount Katahdin, has as elevation of 5,200 feet above sea level. Maine is not specially a mineral State. It is noted, however, for its fine building stones and for its lime, which is extensively manufactured and exported. There are some promising deposits of iron, and mines of lead, zinc, silver, and copper. The roofing slates are very fine.

The exhibit at the Exposition was made officially by the State. The mineral department was not large. There were ten cubical blocks of granite of about one foot face, specimens of galena, blende, chalcopyrite, mica, graphite, native silver, and silver ore from Deer Island, quartz and feldspar

from Auburn, tin ore from Winslow, terra cotta, including drain pipes and large vases. It is not generally known that gold has been produced in Maine. The precious metals deposited in the United States Mints up to June 30, 1883, was as follows:

Gold	$5,592 69
Silver	22 00
	$5,614 69

MARYLAND.

One of the original thirteen States. Area, 11,124 square miles. Population in 1880, 934,943. Capital, Annapolis. Floor space at Exposition, 8,262 square feet. The State is divided into 23 counties. The surface of the eastern shore is generally low and level. The northwest is mountainous. The Alleghany Mountains cross the State, but do not rise to a great height. In the bare hills near Baltimore chromic iron was found in large quantities and was extensively mined and exported, principally to Scotland. It was for many years a noted locality, but the deposits, if not exhausted, are at least less productive, and the demand for that useful mineral is now to a large extent supplied by California. There are some mines of copper in the State, and iron ores are raised and smelted in numerous blast furnaces. Limestones and marbles of good quality are found. The serpentines are worked for magnesia. Maryland has extensive coal fields which are largely worked. The celebrated Cumberland coal comes from this State. Some gold has also been found, although the amount is but small. Maryland is credited with a deposit of $1,600 15 in the Mints of the United States.

The Maryland collective exhibit at the Exposition was by the State and the City of Baltimore. An appropriation of $5,000 was made by the State. Some of the minerals and natural history specimens were sent by the Academy of Sciences of Baltimore and arranged by Professor Otto Lugger.

The mineral exhibit was large and important. The best specimens were placed on flat table cases. The collection consisted of minerals, rocks, fossils, ores, and manufactures. Of minerals the following were the most interesting: asbestus; chalcopyrite, fine; hematite; limonite; quartz crystals, large and fine; serpentine; stalactites; steatite.

Of rocks and building materials there were shown: building stones in many rare and beautiful varieties; bricks, white and red; clays; granite; glass sand; hydraulic cement; marbles. On a special table were placed a variety of marbles and breccias of various colors and varieties, some very fine and beautiful. One piece was a fac simile model of the Washington Monument, five feet high, made of the same marble, from the Beaver Dam Marble Quarries, Baltimore County.

Slates of the best quality for roofing, called peach blossom slate. There was also shown terra cotta in considerable variety. One very artistic panel represented a group of boys in a laboratory, playing with an electrical machine. There were also ornamental, glazed, and pressed brick, fire-brick and ornamental tiles. One of the most beautiful specimens of this class shown was a block of green, verde antique marble, the finest I have ever seen. It was 8x10x4 inches, beautifully polished. A slab of this stone was exhibited at the Paris Exposition of 1878, where it attracted much attention and was greatly admired.

Of fossils, there was a large exhibit in flat table cases. It included palæontological specimens from the Hamilton, Medina, Permian, and Coal measures. The coal flora was specially fine. There were also two

cases of Tertiary fossils, including many shark teeth, resembling those from South Carolina. All the fossils were from the State.

The ores were displayed on large terraced tables. They represented considerable variety, and were of importance. The iron ores and coals were shown in large quantities, the latter in cubical blocks.

A special exhibit of manufactured copper was made by the Baltimore Copper Company; some of the copper sheets were very large.

A case of Maryland minerals was loaned to the State by A. E. Foote, of Philadelphia. It contained many large and showy specimens, but they were not labeled. One specimen of native gold in quartz from near Alexandria was quite a surprise, as I had no idea quartz could be found in that locality.

A very interesting and remarkable ethnological collection was exhibited by Prof. S. V. Redizer, of Zion School, Baltimore.

A special exhibit was made by the Baltimore and Ohio Railroad Company. One of the most interesting specimens was an exquisitely sculptured block of blue sandstone from Cheat River. The Johns Hopkins University building, in Baltimore, is built of this stone. The block was about ten inches cube. This company showed also coke, iron, granite, iron ores, coal, limestones, building stones, bricks, enameled and pressed, and ornamental tiles, terra cotta, etc. All the specimens were fine.

MASSACHUSETTS.

One of the original thirteen States. Area, 7,800 square miles. Population in 1880, 1,783,085. Capital, Boston. Floor space in Exposition, 7,031 square feet. The State is divided into 14 counties. The surface is diversified. The western portion is mountainous; further east lies the valley of the Connecticut River. The eastern and northeastern portion is hilly, and the southeastern generally low.

The principal mineral resources of the State are building stones, principally granite; iron ores, and a few of lesser importance. Attempts have been made to work certain trivial veins of lead, containing a little silver, gold, and copper, but without successful results. Up to June 30, 1883, Massachusetts silver was deposited in the United States Mint to the value of $917 56.

The collective exhibit at the Exposition was made by the State officially. The mineral exhibit was not large, but the specimens were all exceptionally fine and well selected. The building stones were highly finished and polished.

Of the minerals shown the following were the most important and interesting: beryl, one large crystal, 5 inches in diameter, was from Royalston; chalcopyrite; feldspar, used in making glass; garnets, fine; graphite; limonite; pyrite, used in making sulphuric acid; quartz, used in glass making and in pottery; spodumene.

Of ores, there were some iron ores, and a large specimen of quartz, said to contain gold, from Medford.

Rocks and building stones were represented by many fine specimens, including an exquisite column on pedestal. The column was partly polished and chiseled to show a vine in polished relief.

Marble dust very extensively used and scythe stones of mica schist.

Fine red terra cotta tiles, ornamented bricks, and elegant vases were also shown, and fine slabs showing tracks of birds and animals, and others with ripple marks and rain drops. These were very interesting.

MICHIGAN.

Territory, June 30, 1805. State, January 26, 1837. Area, 58,915 square miles. Population in 1880, 1,636,937. Capital, Lansing. Floor space in Exposition, 6,750 square feet. The State is divided into 77 counties. It is divided naturally into two peninsulas bordering on Lake Superior, Lake Michigan, Lake Huron, Lake Erie, and Lake St. Clair. The southern peninsula is generally low and flat, and is devoted to agriculture. The northern is rugged and mountainous, with streams falling so rapidly as to afford abundant water power.

The summits of the Porcupine Mountains rise to an altitude of 2,000 feet. The northern peninsula affords an abundance of valuable minerals, the principal being copper, iron, salt, slate, and gypsum; the first is the most important and valuable. The yield of metallic copper from 66 mines during 29 years, from 1855 to 1883, was $386,659\frac{1934}{2000}$ tons, the value of which was $172,035,566. The above figures are taken from a statistical table by A. P. Swineford, Commissioner of Mineral Statistics, 1884. From the same publication we learn that from 1860 to 1883, inclusive, salt was produced to the extent of 27,547,727 barrels; from 1866 to 1883, inclusive, gypsum was manufactured as follows: ground plaster, 734,675 tons; plaster of Paris, 1,234,943 barrels of 300 pounds each.

In 1845 iron ore in paying quantities was found. The first iron manufactured was in bloomeries. In 1858 the first iron furnace commenced operations, since which pig iron has been largely produced. Coal is mined in a small way. The copper mines of Lake Superior were anciently worked by a people who used stone axes and hammers. There was no tradition among the Indians showing that the mines had been worked. On Isle Royal a multitude of battered stone hammers have been found. The plan adopted by the ancient miners to obtain the metal seems to have been the building of fires on the outcroppings and sudden quenching the hot rocks with water, by which they became cracked and partially disintegrated. They were then broken down with stone hammers and the copper picked or broken out. There is no reason to suppose that they melted the metal, but it was most probably hammered into articles of use and ornament.

The principal copper mines are on Keweenaw Point and Isle Royal. Michigan is the most productive copper region in the world except Chili. The metal is associated with silver, not in the form of an alloy, but in joined masses. This association is very remarkable. Ontonagon, Houghton, and Keweenaw are copper producing counties. The principal iron mines lie in Marquette County. At one time the production of iron was greater than that of any State except Pennsylvania. Both silver and gold have been produced in considerable quantities. The precious metals deposited in the United States Mints up to June 30, 1883, from Michigan:

Silver	$3,528,339 72
Gold	139 71
Total	$3,528,479 43

The exhibit at the Exposition was made officially by the State.

The mineral department was valuable, extensive, and instructive. Fifty-five mines of copper and iron were represented, and one of gold and silver. The most important mineral exhibit was of copper and iron in the form of ores, metal, and manufactured articles. In the mines the copper is nearly

all found in a metallic condition; sometimes in large masses, at others disseminated through a trachytic rock with epidote. This is crushed, concentrated, and the copper melted. Large masses are not so easily handled. When not larger than five or six tons they are hoisted out and placed in reverberatory furnaces where they finally melt and run into kettles from which the metal is ladled into ingot molds. If larger they must be cut. This is an expensive operation as well as difficult and laborious. After many experiments it has been found most practical and economical to cut with cold chisels into masses of the above size or less. The cutting is done by hand at an average cost of one dollar per superficial inch of surface. Contracts are sometimes made at a less rate. Ingots of red copper were shown, also copper bars and magnificent ores of copper from the various mines. One special case was devoted to the display of specimens of rare beauty and richness. The difference between the copper ores shown by Arizona and by Michigan was very remarkable. The Detroit Copper and Brass Company showed copper and brass wire sheets, rivets, and copper bottoms for teakettles and wash boilers, tinned on one side.

Some large and fine specimens of iron ores were shown. They were hematite, magnetite, and specular iron.

One specimen of gold quartz was labeled as assaying from $3 to $80 per ton. From the appearance of the rock I was compelled to take this statement with considerable allowance.

Fine building stones were shown. Some fine grained sandstones and brown slates, of excellent quality, and in every way suited for roofing. The slate could also be cut into pieces suitable for use as billiard table tops. The slates come from Baraga County.

Gypsum of excellent quality was shown from Grand Rapids. It is largely used as a fertilizer, and for building and other purposes.

A preparation called "alabastine" was exhibited from Grand Rapids, which is used as a substitute for kalsomine. The base is calcined gypsum. It is in the form of a white or colored powder. For use it is mixed with boiling water and laid on the wall with a brush. It is said to be extensively used.

Large quantities of salt, both crude and manufactured, were also shown.

MINNESOTA.

Territory, March 3, 1849. State, May 11, 1858. Area, 83,531 square miles. Population in 1880, 780,773. Capital, St. Paul. Floor space at Exposition, 10,175 square feet. The State is divided into 75 counties. Minnesota is a plateau State, lying nearly in the center of the continent. It forms a catchment basin in which three of the great river systems of North America head. The St. Lawrence, the Mississippi, and the Red River of the North all have their fountains in this State. The highest land in the State is 1,680 feet above the sea-level, and the average altitude is 1,080 feet. The principal economic minerals found in Minnesota are iron, copper, slate, limestone and other building stones, peat, and salt. Ores of gold and silver have been discovered on the shores of Vermilion Lake, but the quantity and quality are unknown.

The collective exhibit was made officially by the State, and an appropriation of $32,000 was provided for that purpose. The mineral exhibit was

under the charge of Prof. N. H. Winchell, State Geologist, assisted by his son, Horace V. Winchell. The most important part of the collection was from the general museum of the University of Minnesota, geological and natural history survey. This consisted of specimens of nearly uniform size, embracing the rocks and minerals of the State, all very fine and well selected. There were cases filled with characteristic fossils; also a large collection of geological maps, photographs of scenery, etc. Many copies of the geological surveys of the State were distributed. The most prominent specimen in this exhibit, and the most imposing in the building, was a monument of stone weighing 21 tons, from the quarry of W. B. Craig & Co.—the Mankato Empire stone ledge.

This quarry has been opened about twenty-five to thirty years, but has not been worked extensively until purchased by the present owners three years ago; has a frontage of 1,500 feet; is opened to full depth of ledge, about 40 feet, consequently can furnish any dimension desired in the way of bridge stone, coping, engine beds, flagging, sawed work, flooring, tiling, and all kinds of house work. This quarry, having been worked so extensively for the last three years, is now in condition to furnish a better quality of stone than ledges generally do.

Mankato ledges have furnished stone for the arch bridge at Minneapolis, Blair bridge on the Missouri River, a large number of bridges on the Minnesota and Blue Earth Rivers, Seventh Street improvement arches, St. Paul, piers on Cedar and Iowa Rivers, piers on C. & N. W., C. St. P. M. & O., M. & St. L. roads, piers for N. P. railroad bridge, Superior, St. Louis River, curbing, guttering, and paving for St. Paul, Minneapolis, and Omaha, building stone throughout the States of Wisconsin, Iowa, Nebraska, Minnesota, and Dakota Territory.

This monument is more fully described in the following paper on the mineral exhibit, by Professor N. H. Winchell, State Geologist, specially prepared at my request:

THE MINERAL EXHIBIT OF MINNESOTA AT THE NEW ORLEANS EXPOSITION, BY N. H. WINCHELL, STATE GEOLOGIST.

Of the actual mines of this State but little can be said, since the iron mines, situated near Vermilion Lake, are the only ones in existence in the State. Great hopes and expectations, however, are lately excited by reports of gold and silver discoveries in the northern part of the State, but these reports lack confirmation by reliable authority, and may turn out like many another *ignis fatuus* of the prospector.

The mines at Vermilion Lake were opened last year on a large and systematic scale, the output of iron ore, in about two months, being about sixty-two thousand tons. It was carried by vessels on Lakes Superior, Huron, and Erie to furnaces at Cleveland, Buffalo, Pittsburgh, and other eastern cities. It comes at once into competition not only with the carboniferous iron ores of Pennsylvania and Virginia, but with iron ores of the same grade taken from the iron mines in northern Michigan and Wisconsin, which are in the same geological horizon as the Vermilion mines. These iron ores are hæmatite with small quantities of non-titaniferous magnetite and göthite.

About twenty-five hundred pounds of this iron ore were exhibited in the departments of geology, fauna, and flora of the Minnesota State exhibit.

Repeated assays give a content of 66 to 69 per cent of metallic iron, from .03 to .06 of one per cent of phosphorus, and from less than 1 per cent to 5 per cent of silica, with no appreciable amount of sulphur. These analyses show that the ore is sufficiently low in phosphorus for bessemer use,,and ought to rank among the best in the United States. The mines are farther west than any now existing in the Lake Superior district, and probably will ultimately control a large market extending over the western country. They should not long be compelled to send their products to the Eastern and Middle States for smelting and manufacture, whence the same iron is again sent west, perhaps passing through the State of Minnesota to find its place of consumption. The freightage of the manufactured products directly from Minnesota to supply this western demand, will ultimately be seen to be so much cheaper than the carriage of the ores east and the manufactured article again west, that the ways and means for avoiding this double transportation will be sought and found by the shrewd capitalists of the State. Such articles would compete successfully in the western markets with those of eastern manufacture. The coal of Iowa or Illinois would have to take the place of that of Pennsylvania, unless charcoal could be substituted.

In the existence and exploitation of such bodies of iron ore the whole nation takes a deep interest. It opens out another of the avenues in which flow the wealth and industry of the American citizen, and through which return the elements which make up our civilization, and the power that enables us to maintain our rank among the nations of the earth.

These mines are all owned and managed by the Minnesota Iron Company, of St. Paul.

Various other minerals, though not of metallic value, were to be seen in the same exhibit. One of the most curious, and one that has an archæological and poetic interest attached to it, is the famous *catlinite*, or red pipestone, of which numerous articles, as well as calumets or peace-pipes, have been made by the Indians, specimens of which were on exhibition. For a full description of this mineral and of the locality, consult the Final Report on the Geology of Minnesota, vol. I, pp. 537–543. This is the material of the great peace-pipe of which Longfellow writes in his legend of Hiawatha; a legend which was still further illustrated by the little artificial waterfall, a faithful reproduction of the falls of Minnehaha, which splashed a few feet distant.

Another interesting mineral was *thomsonite*, a zeolite from the cupriferous rocks of the north shore of Lake Superior, which exhibited many colors, and, if a little harder, would be very valuable as a gem for jewelry setting. When cut and polished, or when polished without cutting, its internal radiated structure is shown on the surface in cats'-eye forms, or in alternating bands of color which anastomose in a fibrous suture, encircling the whole exterior of the specimen. These specimens vary from white and cream color to red, through pink, and to green. Some specimens that are wholly of a sub-translucent green color have received the name *lintonite*, and considerably resemble, outwardly, the gem chrysoprase.

In this exhibit, also, were numerous specimens of the green-star mineral from Isle Royale, *chlorastrolite*, which is a zeolite from the copper-bearing rocks of Lake Superior. It weathers out as the trap rock decays, and is found among the gravel stones on the beach of the lake. It takes a good polish and its color is spotted light and dark green. Besides these, various other zeolitic minerals from the igneous rocks, and all the usual minerals of the archæan rocks, were to be seen in this exhibit. The crystalline rocks were represented serially by hand samples dressed three inches by four inches and about one inch thick. Two large masses of native copper, one found at Taylor's Falls, and one, weighing eight pounds and containing a large per cent of silver, alloyed with the copper, found at Temperance River, on the north shore of Lake Superior, in the State of Minnesota, were objects of much curiosity and examination. These samples have been derived from the copper-bearing rocks by the natural decay of the rocks and the transporting agency of the glacial epoch. Such are not infrequent in the drift deposits in the eastern portion of the State. Yet, notwithstanding these indications of the presence of copper in these rocks, and after considerable prospecting and some shafting into the beds in favorable localities, no successful mining of copper has yet been done in the State.

Besides the foregoing, and not mentioning especially the exhibit of stoneware from Red Wing, kaolinic and pottery clays, and the soils, which were displayed in covered glass jars, the roofing slate, the red pressed brick from Dresbach and Duluth, nor numerous objects of geological interest, the Minnesota exhibit contained a full series of the native building stones of the State, embracing granite, gabbro, sandstone, quartzite, and limestone. The granites were represented by a monument rising about sixteen feet, from the quarries at East St. Cloud, in Sherburne County, supplied by Breen & Young, who own and work the quarries. This is a gray firm medium grained granite, containing hornblende, capable of sustaining a pressure, according to the tests of General Q. A. Gilmore, of 28,000 pounds per square inch. Besides this monument, several cut blocks a foot square illustrated this stone. Mr. Quimby, of Duluth, exhibited a small monument of the gabbro, which he works, showing on one side a beautiful polish. This is generally known as "Duluth granite" though in no sense a granite if the term be properly used. This rock consists of labradorite, principally, and of diallage and magnetite. Very rarely can any of the internal iridescence that labradorite frequently exhibits, when partly decayed, be seen in this rock. It cuts easily, *i. e.*, more easily than granite, because it contains no quartz, but it is tough rather than hard, and hence does not break under a blow from the hammer as easily as granite. Its strength is 27,250 pounds per square inch. Before the close of December, Mr. Quimby's monument was sold to Mr. George Stroud, marble dealer, of New Orleans.

The potsdam quartzite, from Pipestone County, was exhibited by several cut blocks and by a large glaciated slab, and by another curiously ripple-marked slab. This rock, though very hard, is being considerably used. It can be broken with facility. Its fractured edges are straight, and the builder can avail himself of the natural surfaces as broken from the quarry, in the dressing of his blocks for the building, thus avoiding much of the cost of facing. Its color is red or light red, and its strength under pressure is 27,750 pounds.

The sandstones exhibited were from the Upper Cambrian (St. Peter, Jordan, and St. Croix formations), and were rather soft and friable to serve extensively for general building. It is possible that after the quarries are more wrought the hardness of the stone will increase. They were from Jordan, in Scott County, from Dresbach, in Winona County, and from Hinckley, in Pine County. The last mentioned is a promising sandstone. It has a medium sized grain, and a reddish-buff color, and greater hardness than any of the others. It is mainly silicious, while those from Jordan and Dresbach are also feldspathic and even micaceous. Besides these sandstones, which are light colored or gray, a brown sandrock quarried at Fond du Lac, was also exhibited in blocks cut one foot square. This is a durable and valuable building stone, though evidently also feldspathic.

The dolomites or dolomitic limestones played a very important part in the mineral exhibit of Minnesota. Cut blocks, one foot square, were exhibited from Red Wing, Frontenac, Winona, Stillwater, Mankato, Kasota, and Nininger. These were all very similar buff dolomites, but containing a noteworthy per cent of silica. They are extensively used for building, and have acquired throughout the northwest an enviable reputation for their excellent qualities. They are in heavy beds, easily wrought, very durable, have a light and attractive clean exterior, and can be cut into ornamental forms with safety. The Frontenac stone especially, which stands among the first, and was also exhibited in a baptismal font 3½ feet high, cut entirely from one block, has a finely porous, open structure; the Kasota stone has a light yellowish-pink or "fawn-color," and the Winona and Red Wing samples were of a light buff, similar to those from Nininger and Stillwater, though somewhat more coarsely vesicular. The Mankato stone was exhibited by one of the most imposing objects in the whole building. This was a spindling monument, four feet square at the base, made of nineteen blocks, rising thirty-three feet above the floor. This was surmounted by a staff which supported a gilded crescent, which, on either side bore the motto *L'Etoile du Nord*. Slightly above the crescent, resting upon an invisible wire, glittered a golden star, the highest object erected within the building. This monument was designed and constructed by W. B. Craig & Company, of Mankato, and was intended to show the alternations of the natural layers of the quarry from which the blocks were taken, from bottom to top. This monument was left standing in its place when the Minnesota exhibit was dismantled and returned home. If its foundation be made more secure it will form a permanent ornament in the park after the buildings are removed. It is well worth preservation and would be one of the most lasting mementoes of the great Exposition.

Other limestones, less magnesian, were similarly illustrated by square blocks, six inches in thickness. These came from Mantonville, in Dodge County; from Clinton Falls, in Steele County; from Minneapolis, in Hennepin County; and St. Paul, in Ramsey County. These are less desirable stones, but some of them are extensively used, particularly those of St. Paul and Minneapolis, where foundations for nearly all structures are made of this blue limestone, taken from the Trenton formation.

There was on exhibition, also, in this department, a jar full of chloride of sodium, or common salt, made from the brine of a flowing well in Kittson County, in the extreme northwestern corner of the State. This manufacture is not carried on as yet as a regular business, the brine having been discovered but recently, in the sinking of a well for domestic and farm uses. But this salt points out another natural resource of the State of Minnesota, which may develop hereafter into important proportions.

Mention should also be made of a very fine collection of meteorites, from all parts of the world, which was to be seen in this exhibit. This collection numbered 66 specimens, from as many different localities.

MISSISSIPPI.

Territory, April 7, 1798. State, December 10, 1817. Area, 47,156 square miles. Population in 1880, 1,131,597. Capital, Jackson. Floor space at Exposition, 11,812 square feet. The State is divided into 73 counties. The surface of Mississippi, except the Mississippi bottom, is generally hilly and undulating. The highest land is less than 800 feet above sea level. The collective exhibit was very fine and extensive, but the mineral display was small.

MISSISSIPPI STATE EXPOSITION BUREAU.

Gov. Robert Lowry ---- President.
Gen. S. D. Lee ---- A. and M. College, Prof. of Mineralogy and Geology, University of Miss.
E. G. Wall ---- Jackson.
S. A. Jonas ---- Aberdeen.
J. G. McArthur ---- Daleville.
J. Poitevant ---- Pearlington.
Wm. Oliver ---- Wesson.
A. B. Hurt ---- Winona.
A. M. Paxton ---- Vicksburg.
M. L. Jenkins ---- Meridian.

At the first meeting of the Exposition Bureau, held March 28, 1884, Major S. A. Jonas was unanimously elected as State Commissioner, and was directed by the President to take charge of the whole work of making an exhibit of the vast resources of Mississippi at the World's Exposition at New Orleans, Louisiana.

The special geological exhibit was made by Dr. M. D. Spillman, of Columbus. It consisted largely of Permian, Cretaceous, and tertiary fossils, most of which were very fine and in an excellent state of preservation. An arrangement has been made with Dr. Spillman by which duplicates will be obtained for the California State Museum.

The minerals shown were but few, consisting of galena formed in nodules, selenite, limonite, hematite, lithomarge, yellow ochre, lignite—poor. Of rocks there were some good building stones, soils; clay, and brick made from the clay, the latter with a peculiar mottled appearance. Glass sand, from Pascagoula, and glass made from it. Pottery and terra cotta, from Holly Springs.

The crowning glory of this collection was the spine and part of the skeleton of Zeuglodon cetoides, found in Jasper County, by Prof. L. C. Johnson, of the United States Geological Survey, and arranged by Dr. W. Spillman. The individual was 80 feet long. Some fine teeth were found with it.

It has long been believed that gold existed in this State, but according to the investigations made by Prof. Wailes, State Geologist, the precious metal has only been found in minute grains at one locality, and not in paying quantity. There seems to be in the State a propensity to play practical jokes or to hoax the credulous, alluded to by Prof. Wailes. I mention this here because a specimen was sent to me from Mississippi which was manufactured purposly to deceive. On the other hand I was shown a specimen of granular quartz rich in gold, said to have been found near Jackson. From its strong resemblance to the ores of Georgia and North Carolina, I have no faith in the story of its being picked up on the surface in Mississippi, as claimed; still, this State lies in the general direction of the gold belt, and that metal may be eventually found.

MISSOURI.

Territory, 1812. State, August 10, 1821. Area, 65.350 square miles. Population in 1880, 2,168,380. Capital, Jefferson City. Floor space at Exposition, 6,000 square feet. The State is divided into 114 counties. The Missouri River divides the State into two unequal parts. The southern portion is hilly, increasing in altitude as the Ozark Mountains are approached. The northern part is more level.

The principal economic minerals found in the State are coal, lead, iron, and building stones. The coal beds cover an area of 7,000 square miles. Veins of 18 inches are considered workable.

The State made an appropriation of $5,000, which, joined to the same amount received from the Exposition, made up the small sum from which the fine collective exhibit was made.

The Commissioner applied to Professor G. C. Broadhead, State Geologist, and other prominent citizens, by whose combined efforts the State exhibit was made. All the labeling of minerals and geological specimens was by Professor Broadhead. No reports or maps could be obtained.

The State collection of minerals was displayed on terraced tables. The collection was not large but contained interesting and fine specimens.

The most noteworthy minerals shown were: azurite; barite, fine; blende in dolomite; calamine, fine; calcite, galena, and blende, all fine, the latter in splendid crystals; calcite, dog-tooth variety, fine crystals; coal; galena in very fine cubes; galena with blende, both finely crystallized; pyrite, cockscomb variety, very fine; specular iron, Pilot Knob, fine; specular iron, Iron Mountain; ores, etc; fire-clay; fire-bricks; clay retorts. A large private exhibit of terra cotta, consisting of ornamental terra cotta, sewer pipes, fire-brick, etc., and one glass-maker's pot, all by Evens & Howard of St. Louis, and a similar display by Reeves & Kirkpatrick of Calhoon; clay used in the manufacture of ironstone ware; a fine display of brick by the Hydraulic Pressed Brick Company of St. Louis. This exhibit consisted of pressed and ornamental brick, and an elaborate and magnificent circular fireplace and mantel, with wainscoating and ornamental surroundings, all in brick-work, certainly the finest work of the kind I have ever seen. Great credit is due to the builders for this artistic handling of a base material.

Iron ores in very large specimens from Iron Mountain were shown, and pig lead. Pig iron in great quantities was exhibited by the Missouri Pacific Railroad Company. *Rocks and Building Stones*—granite crushed, used in the manufacture of artificial stones; granite in blocks; marble, red, very fine; porphyry, serpentine—sap green, with darker green blotches or irregular spots. Syenite—red and gray, one cylinder and one foot cube of each, Syenite Granite Company of St. Louis. There were also 20 table cases of ethnological specimens. The whole collection was offered for sale for three thousand dollars. It would redound to the credit of our California public spirited citizens if they would purchase for the State Museum some of the very fine collections sometimes offered for sale at very low rates.

NEBRASKA.

Territory, May 30, 1854. State, March 1, 1867. Area, 75,995 square miles. Population in 188–, 452,402. Capital, Lincoln. Floor space at Exposition, 8,325 square feet. The State is divided into 65 counties. Nebraska is a vast plain, sloping gently towards the Mississippi River. There are no mountains except at the west, where the Black Hills and Rocky Mountains

begin to rise. But few minerals seem to be worked in the State. Building stones and good brick clays abound, as do also potter's clays. As coal is scarce peat is to a considerable extent utilized. Extensive salt springs are found in the State, and alum slates are known to exist.

The State is specially suited for agriculture, and the agricultural exhibit was very grand and comprehensive.

The mineral display was very small, almost nothing, consisting only of some coal from Richardson, a few building stones and bricks, and a column showing the thickness of the soil in Elk Horn Valley (nine feet).

NEVADA.

Territory, March 2, 1861. State, October 31, 1864. Area, 104,125 square miles. Population in 1880, 62,266. Capital, Carson. Floor space in Exposition, 3,495 square feet. The State, which is larger than any other except Texas and California, is divided into 14 counties. The general surface of Nevada is table land, with an average altitude of 4,500 feet. The highest land is about 8,000 feet above sea level.

The principal economic minerals in the State are silver, gold, borax, salt, lead, sulphur, copper, antimony, gypsum, marble and building stones, nitrate of soda, manganese, and good clay, suitable for the manufacture of pottery and brick.

Nevada is properly called the Silver State, the output of that metal being almost as remarkable as that of gold in California. The State collection was shown in twenty glass table cases. There was no special separation of the minerals from the ores, and the collection included many fine specimens from localities outside the State. In the description which follows none but those from Nevada will be mentioned. Besides the minerals in the cases there were large piles of characteristic ores from the most important mines of the State, including those of silver, gold, lead, antimony, quicksilver, nickel, cobalt, etc., and a large collection of photographs of scenery, mining views, machinery, mills, furnaces, etc.

While the lands are not generally suitable for agriculture they are fertile and could be made to support a large population if water could be procured for irrigation.

The mineral exhibit of Nevada at the Exposition was really very grand and comprehensive. It was under the charge of W. M. Havener, in the absence of the Commissioner. Mr. Havener not only carefully guarded the specimens, but employed his whole time in calling attention to the resources of his State. California, Nevada, Arizona, and Oregon formed a special Pacific Coast group, with interests in common, and were mutually proud of each other.

The most interesting minerals shown were: amethyst crystals, very fine, Belcher Mine; azurite; borax crystals, very fine; calcite crystals, Justice Mine, fine; cerusite, in fine needle crystals, Hamburg Mine, Eureka County; chalcedony, pink and white, Aurora, Esmeralda County; chalcanthite (sulphate of copper), Bluestone Mine, Lyon County; cinnabar, Steamboat Springs; diatomaceous earth, large cubical specimen on pedestal; erythrite, Churchill County; gay-lussite, Ragtown Lake; gold crystals, Red Cañon, Douglas County; nitrate of soda; obsidian, variegated; pisolite; pyrargyrite; salt, solar crystals; selenite, from a deposit said to be 40 feet thick; native silver, very fine, Cortez District; sphalerite, zinc blende; stibnite, Battle Mountain; sulphate of alumina; sulphur, Steamboat Springs; sulphur, Rabbithole Mountains; tourmaline (black), in white quartz, Washoe

County: turquoise, Esmeralda County; ulexite; wulfenite, extra fine crystals, Eureka County; wulfenite, Tecoma, Elko County.

An interesting and valuable exhibit of rock specimens from the walls of the Overman Mine was made. These specimens numbered 464, of uniform size. They were taken every five feet to the 2,340 foot level. From a scientific standpoint this collection was specially interesting and attractive. They were donated to the State of California, as shown in the following correspondence:

OVERMAN MINE, FORMAN SHAFT, SUPERINTENDENT'S OFFICE,
VIRGINIA CITY, NEVADA, May 3, 1885.

Mr. Henry G. Hanks:

DEAR SIR: You will probably remember having a conversation with Col. Samuel T. Curtis and myself, in San Francisco, about samples of the rock taken from the Forman Shaft, and your expressing a desire to obtain them for your State collection.

Col. W. M. Havener, Deputy Commissioner for this State, has them on exhibition at New Orleans, and if you still desire to obtain them, I will present them to you for the cabinet of the State of California, and you can ship them directly to San Francisco with your exhibit when you return them. I will also present the cabinet I had made for them, if your State will pay the expense of transporting it from this place to San Francisco.

Yours truly,

CHARLES FORMAN.

CALIFORNIA STATE MINERAL EXHIBIT,
WORLD'S INDUSTRIAL AND COTTON CENTENNIAL EXPOSITION,
NEW ORLEANS, May 10, 1885.

Mr. Charles Forman, Superintendent Overman Mine, Virginia, Nevada:

DEAR SIR: I am in receipt of your letter dated May third. I cordially thank you, in the name of the State of California, for the magnificent donation you have announced.

Of all the specimens in your grand Nevada State exhibit, the section of your shaft shown by the specimens indicated, has been the most interesting to me. I am well aware of the labor and foresight required in making this section, and the important lesson it teaches. I promise you that it shall be well displayed in the new museum building, and that we will, in the near future, have sections cut and mounted for the microscope.

Our museum is fortunate also in the possession of a full series of rock specimens from the Sutro Tunnel and its branches. The two collections will be displayed together, and will always remain for inspection and study in the California State Museum.

Col. Havener requests me to say that he has received from you an order to transfer the collection at the close of the Exposition.

I have the honor to remain, very truly,

HENRY G. HANKS,
State Mineralogist.

The production of silver and gold by the State of Nevada has been very large; the exact amount will never be known, because no official record has been kept.

The total deposits of the precious metals from that State in the Mints of the United States up to June 30, 1883, were as follows:

Silver	$85,657,436 82
Gold	18,523,757 41
Total	$104,181,194 23

The total yield of both metals from 1861 to 1874, inclusive, has been estimated at $169,000,000.

The Consolidated Virginia Mine alone yielded to September 30, 1876:

Silver	$20,656,299 65
Gold	15,477,620 71
Total	$36,133,920 36
Number of bars	10,874

The California Mine produced during the same period as follows:

Silver	$5,044,382 32
Gold	4,631,337 15
Total	$9,675,719 47
Number of bars	2,452

Total yield of both mines:

Consolidated Virginia	$36,133,920 36
California	9,675,719 47
Total	$45,809,639 83
Total number of bars	13,326

The great Comstock ledge is at the present time practically exhausted, but new ore bodies may be found both north and south of the old workings which still contain much low grade ore, which in the bonanza times was considered too poor to work, but with lower prices and cheaper labor, can be extracted with profit, and the great mine is likely to yield a moderate annual crop of silver for many years to come. Other mines in the State are also very promising, and it is not to be supposed that all the rich silver mines have yet been discovered. Other minerals are utilized. The borax produced has been given in the third annual report of this office. This is likely also to be produced for many years. The same may be said of salt, nitrate of soda, sulphur, and other minerals, all of which will add to the future prosperity of Nevada, our sister State.

NEW HAMPSHIRE.

One of the original thirteen States. Area, 9,392 square miles. Population in 1880, 343,991. Capital, Concord. Floor space in Exposition, 4,805 square feet. Divided into 10 counties. The surface of the State is diversified. It is crossed by the White Mountains. Mount Washington is 6,293 feet high, but the average elevation of the State is but 1,200 feet above sea level.

While New Hampshire is not a mineral State some ores are found, but have not been extensively worked. Gold has been extracted; as shown by the reports of the Director of the Mint, that State is credited with deposits of gold in the Mints up to June 30, 1883, to the value of $11,020 55. Auriferous quartz is mined at Lisbon. Some iron mines have been somewhat worked. The ores are magnetite, hematite, and specular—but little pig iron has been produced. Some ores of copper and lead are also found. Chalcopyrite with other copper ores has been discovered in some quantity at Gardner's Mountain. Pyrites, suitable for the manufacture of sulphuric acid, is rather abundant, and a small deposit of tin ore has been mined at Jackson. Of minerals the following are known: beryl, mica, idocrase quartz crystals, cyanite, staurolite, molybdenite, graphite, tourmaline, garnets, galena, chalcopyrite, columbite, iolite, and others. Mica is quite extensively mined. Granite is largely quarried—the Concord granite has a wide reputation well known.

The mineral exhibit by this State consisted of twelve cubical blocks of granite and other building stones, all highly polished, and a relief map on a scale horizontal of one mile to the inch and a vertical scale of 1,000 feet to the inch. The effect of this map was very fine. California should have a similar one. The collective exhibit was made by the State.

NEW YORK.

One of the original thirteen States. Area, 47,000 square miles. Population in 1880, 5,082,871. Capital, Albany. Floor space in Exposition, 7,200 square feet. State divided into 60 counties. The surface of the State is very irregular. Some parts are mountainous, others are nearly level plains. The economic minerals are iron, building stones, roofing slates, lead and copper ores, salt, gypsum, hydraulic cement, petroleum, etc. No State in the Union has been so carefully or thoroughly studied geologically. Many voluminous reports and maps have been published. Professor James Hall has been for many years State Geologist. His son, Charles E. Hall, was in charge of the mineral exhibit at the Exposition. The collection consisted principally of fossils and rocks from the Geological Survey collections at Albany. They were placed in four table cases and were beautifully arranged and shown. Some of the fossils and rocks were types and were the most perfect obtainable. One case contained thin slices of fossils and photographs of the same, magnified 20 diameters. They were prepared by C. E. Beecher, of the New York State Museum at Albany, and were the finest specimens of rock sections I have ever seen. The machine by which these remarkable sections were cut is figured in the Thirty-fifth Annual Report of the New York State Museum of Natural History, and some of the photographs are reproduced in the same volume. The specimens were large and thin, and were mounted on ground glass and so placed that the light passed through them from behind. There were 97 sections of well known fossils in the case. This was a most remarkable exhibition of the kind.

The iron ores were arranged on a pyramidal table, besides which large specimens were piled on the floor. Specimens of ores and pig iron were shown by the Port Henry Iron Company, Jefferson Iron Company, Antwerp, and others.

Large blocks of building and ornamental stones were shown. There were some splendid specimens of fine-grained marble. Of the ornamental stones the ophite marble, exhibited by the Ophite Marble Company of New York, was the most beautiful. Ophite, from *ophites* (snake stone), is a variety of serpentine, so called because it is mottled like the skin of a serpent. The quarry, from which this beautiful stone is taken, is at Moriah, New York, but the works are at Swanton, Vermont. The specimens were in great variety, in slabs, blocks, and columns. The mottled ones were remarkably fine. The company has informed me that a fine specimen will be sent to the California State Museum.

One of the most interesting features of the New York exhibit was a column, thirty feet or more in heighth, showing a stratagraphical section of the rocks of the State from the gneiss to the carboniferous conglomerate. It was an imposing object in the Exposition. There were also five maps of deposits of iron, petroleum, lead, graphite, salt, and gas wells in the State, the work of the geological survey.

Some fine terra cottas in many varieties, from Glen's Falls, were shown. They were red and buff colors, also plain molded and pressed brick architectural terra cotta of elegant design in red and buff, common brick, fire bricks, ironstone pottery, and slabs of marbleized slate.

Of minerals there were but few shown. A small case of New York minerals was loaned by A. E. Foote of Philadelphia, but the specimens were not catalogued. The Dixon Graphite Company had a small showcase of graphite from Ticonderoga and manufactured articles.

Some fine specimens of salt in its manufactured state were also shown. S. Dessau of New York made a fine exhibit of diamonds in the rough from Brazil and South Africa and finely cut stones; also, black carbons used in the arts for cutting hard substances and for diamond drills. The largest rough diamond shown weighed six carats and the largest carbon eight carats.

The Cleveland gem displayed in this exhibit was a very attractive and beautiful object, one not often seen in America. From Mr. C. W. Kennedy, who was in charge, and from a letter from Mr. S. Dessau, in answer to one from me asking certain questions, I obtained the following information concerning this magnificent gem. The rough stone weighed 78 carats = 312 grains. It was found some ten years ago in Kimberly, South Africa, brought to London and held for nine years by a syndicate who expected to sell it to some potentate. It was purchased and cut by Mr. Dessau, and when Mr. Cleveland became President of the United States it was named the "Cleveland gem." It required three months to cut it. It is one shade off absolute white color, but is without any flaw. It has 128 facets, which are more than on any other stone. It is cut according to the rules of Jeffries, the angles being 90 degrees. The present weight is 42¼ carats = 169 grains. This stone remained three months at the Exposition, when it was sold to a well-known actress for $40,000, and is now in Scotland, where it attracts much attention, being the first stone of its value ever cut in America. Mr. Kennedy allowed me to hold it in my hand and to examine it critically, a favor I highly appreciated.

NEW JERSEY.

One of the original thirteen States. Area, 8,320 square miles. Population in 1880, 1,131,116. Capital, Trenton. Floor space in Exposition, 7,400 square feet. State divided into 21 counties. The surface of the northwestern portion of this State is mountainous; central part, hilly; southern, low and generally undulating. The principal economic minerals found in the State are zinc ores, extensively worked; building stones, lime, iron, greensand marl, peat, copper ore, pyrite, etc. The collective exhibit of New Jersey at the Exposition was very imposing. The mineral section was full and comprehensive, being a remarkably fine and well ordered display.

Eight table cases contained the special and really fine exhibit of the State Geological Survey, made under the direction of Prof. George H. Cook, State Geologist. There were also shown very fine geological maps of the State, and reports of the survey. The showcases were a combination of table and vertical, and were placed around a central kiosk. The whole arrangement was in excellent taste. The cases were clean, and the specimens beautifully arranged and labeled.

Two large slabs of red sandstone, with footprints of birds and animals, were conspicuously placed in special vertical cases. They were from the Vineland Quarry, Morris County. The most noteworthy specimens in the table cases were: *analcite*, very fine specimens; *apophyllite*, in calcite, fine; *arsenopyrite*, very fine; *asbestus*, green; *calcite*, in many fine varieties and splendid crystals; *calamine*, also very fine, some in large botryoidal masses; *chalcopyrite; chrysotile*, in serpentine; *copper*, native in calcite; *datholite*, very fine; *dysluite*, with jeffersonite, fine; *fowlerite*, in calcite; *franklinite*, very fine; *garnets*, very large crystals in calcite, the largest ever found, very fine; *graphite*, fine; *hematite*, red, fine; *hydromagnesite; jeffersonite*, fine; *limonite*, large mass, Dickinson's Mine; *limonite*, with sphalerite (zinc

blende), franklinite, and willemite; *magnesite; malachite; marmolite*, fine; *magnetite*, with serpentine; *magnetite*, two large blocks, Hurd Mine, Morris County, with fine specimen of slickensides from the same; *magnetite* (natural magnet), large mass on pedestal; *molybdenite; natrolite*, fine; *orthoclase; pectolite*, very fine; *prehnite* and pectolite, fine; *sapphire; serpentine*, variety known as (precious or noble serpentine), very fine; *siderite*, fine; *steatite*, fine; *stilbite*, fine; *tephroite*, with franklinite; *vivianite*, fine; *willemite*, franklinite, and zincite, two large masses, Sussex County; *zincite*, in flat crystals, very fine.

Of ores, there were shown magnetic iron ores from a number of mines. Many specimens of broken pig iron from Oran furnace, Morris County, and from the Andover Iron Company, Warren County; *pig iron* and manufactured malleable iron, twisted and bent to show texture and quality; spiegeleisen (manganese iron), of 12 and 26 per cent manganese, exhibited by the Passaic Zinc Company; *mineral wool, manganese ores*, etc.

ROCKS, BUILDING STONES AND MATERIALS, POTTERY, ETC.

There were shown 32 blocks of building stones, 5 or 6 inch cubes, and 200 specimens of rocks, all very fine. There were two cases of clays, showing all the varieties in different conditions, from the coarse material to the finest washed sediments, and the minerals added to the clay in the manufacture of fine porcelain.

There was a fine exhibit of porcelain wares, manufactured by the Trenton International Pottery Company, consisting of beautiful chamber and dining sets of semi-porcelain, equal to any I have ever seen; also, plumbers' ware in great variety. A larger commercial exhibit was also made by this company in the main building. A similar display was made by the Mercer Pottery Company, of Trenton, and the Willett's Manufacturing Company. It may be well to say here that all the materials required in this manufacture are found in abundance in California, and there seems to be no reason why our people should not engage in this business to their own advantage and that of the State. Elegant and artistic terra cotta work was also shown, with photographs of specially fine pieces not on exhibition. They were from the works of the Perth Amboy Terra Cotta Company and the A. Hall Terra Cotta Company, of Perth Amboy. A display was made of terra cotta lumber, from the Terra Cotta Lumber Company; this form of building material is described elsewhere. Fine specimens of plain and ornamental brick and fire-brick were shown by several makers.

There was also a fine display of glassware by the Salem Glassworks, including large tubulated retorts, carboys of extra size, graduates, labeled reagent bottles, and other chemical glassware.

Roofing slates of good quality, and manufactured oxide of zinc, were also shown.

Of fossils, a fine mastodon's tooth and a large collection of tertiary fossils were shown, and thirty glass jars of marls.

NORTH CAROLINA.

One of the original thirteen States. Area, 50,704 square miles. Population in 1880, 1,399,750. Capital, Raleigh. Floor space in Exposition, 11,675 square feet. State divided into 94 counties. The coast and swamp land sections of this State extend from 80 to 100 miles inland. The mid-

dle rises gradually to the mountain section in the western part of the State.

North Carolina is a pronounced mineral State, but its resources are only partially developed. The main chain of the Appalachian Mountains cross the State. Sugar Loaf Mountain rises 3,978 feet above sea level, the Grandfather 5,897 feet, and Clingman's Mountain 6,707 feet. In these mountains numerous valuable minerals are found, and no doubt a thorough prospecting would develop others now unknown. The principal minerals now worked are gold, copper, iron, lead, zinc, mica, corundum, etc.

From a handbook of North Carolina, prepared for the State Board of Agriculture, and from other publications, I glean the following information:

Gold is found in 28 counties. It occurs in veins of quartz with sulphurets. Near the surface it is generally associated with limonite, deeper with chalcopyrite, galena, blende, mispickel, and tellurium minerals. The auriferous area covers nearly half the State. The present productive field is 12,000 square miles. In the handbook very many gold mines are enumerated and described.

Gold has been mined in this State from very early times. In several localities in the mountains, ancient shafts have been found of which there is no history. The most important one is in Cherokee County. It is a vertical well timbered shaft, 100 feet deep, with a tunnel extending to the bottom from the foot of the hill. These old workings are supposed to have been made by the Spaniards. The principal counties producing gold are Mecklenburg, Lincoln, Montgomery, Rowan, and Randolph.

From the *Quarterly Journal of Science, Literature, and Arts*, published in London, in 1825, I have made the following extracts:

> "Native gold in North Carolina." Professor Olmstead gives the following account of large pieces of native gold, whilst speaking of this auriferous district: Large pieces of gold are found in this region, although their occurrence is somewhat rare. Masses weighing four, five, and six hundred pennyweights are occasionally met with; one mass was found that weighed in its crude state twenty-eight pounds avoirdupois. This was dug up in Reid's Mine within a few inches of the surface. It was melted down and cast into bars soon after it was found. The spot where it occurred has been since subjected to the severest scrutiny but without any similar harvest. * * * Mr. Reid found a gold specimen in quartz; the gold weighed twelve pennyweights.
>
> The gold country of this district is not less than 1,000 square miles and is situated between the thirty-fifth and thirty-sixth degrees of north latitude, and between the eightieth and eighty-first degrees of longitude west of London.

At the close of 1883, according to the report of H. C. Burchard, Director of the United States Mint, there were in North Carolina 52 quartz mills with 415 stamps, 20 Chilian mills, 8 batteries, 3 chlorination works, and 2 metallurgical works.

During the census year 1880, the precious metals were produced as follows:

Gold	$108,953 00
Silver	100 00
Total	$109,053 00
1881, gold	$115,000 00
1883, gold	$167,000 00
Silver	3,000 00
Total	$170,000 00

Gold and silver from North Carolina deposited in United States Mints to June 30, 1883:

Gold	$10,834,202 79
Silver	47,345 20
Total	$10,881,547 99

Production during the year ending August 19, 1878:

Gold	$160,000 00

The following paper was prepared at my request by C. D. Smith, Geologist and Mineralogist of Franklin, North Carolina, whom I had the pleasure of meeting at the Exposition, in the North Carolina department:

Henry G. Hanks, State Mineralogist of California:

Dear Sir: I regret my inability, owing mainly to the heavy tax on my time in other and previous engagements, to furnish the paper I promised you concerning the gold and gold-bearing rocks of the extreme western portion of North Carolina, and a part, at least, of northeast Georgia. Were I to undertake a full and complete statement of all my observations, and the facts collected during twenty-seven or eight years spent in researches over the gold-bearing region extending from South Carolina to Alabama, it would occupy, no doubt, more space than you could well afford in your report. It will, perhaps, be sufficient, then, if I present a brief collation of the most salient features concerning the geological and lithological relations of the gold-bearing rocks, and my general impressions as to the mode of the occurrence of the gold.

The first fact to be considered, is that the gold does not occur strictly in any one class or series of rocks, though the principal part of the gold production may be traced to a definite geological age (the Huronian). In order to a more thorough understanding of the gold-bearing fields of this southern section, it is proper that I also state that the Blue Ridge mass in its upheaval split and separated the Huronian rocks, which at the time of the upheaval were superimposed upon the granite and gneiss of which the Blue Ridge is composed. The ridge is evidently the crest of a fold in the rocks—a fold, however, that does not stand erect, with anticlinal dip on either side, but a fold broken on the crest, which brings to the surface and exposes the gneiss and granite. This fold is also bent over to the northwestward, giving the strata an inclination to the southeast of an average of about 45 degrees. In this breakage and tilting of the fold, the Huronian rocks are turned under the older rocks, presenting an inverted order as to geological age on the north side of the ridge, while on the south side they are more irregular in their inclination. In some instances they have dropped down on the great granite fold, forming a synclinal dip. At other times they stand perpendicular on edge; and then, again, incline at various angles to the southeast. On either side of this great ridge, the Huronian rocks, and the transition rocks between the Huronian and Azoic proper, constitute the great domain of the gold of the South Atlantic States. It is also a noteworthy fact, that the principal part of the gold found here occurs in or near the bottom beds of the Huronian series, and about the contact of that series with the transition or upper Laurentian, as it has been called. Sometimes gold occurs about the middle of the Huronian series. We have an example of this in Cherokee County, North Carolina. In the granular limestone or marble of the Valley River belt, there occurs a cellular quartz, bearing argentiferous galena and gold. The gold in this case occurs mainly in the quartz, but it is also found as free gold mechanically mixed with the galena. It should be noted, also, that there is neither iron sulphurets nor any other associated minerals with the galena and gold. These limestones, which constitute a member of the Huronian series, are interstratified with the quartzites, slates, and sandstones belonging to that series. Some of these sandstones are of the class designated as itacolumite.

In this same grouping of the Valley-river zone there occurs on the south side of the valley a bed of talco-micaceous slates, which abound in crystals of staurolite. This bed, though in its position overlying the limestone and its more immediate associates, is, in point of geological order, an underlying bed. Along and at the foot of this bed the principal placer mining of the district has been done. All the accumulated gravel heaps from the washings abound in staurolite crystals, and at some points rutile also. The pittings and excavations have been, in many places, pushed up against the staurolite slate, where it rises somewhat abruptly. Fragments and bowlders of the staurolite slate are common upon the surface. I have observed in some of these bowlders fragments of angular quartz and an iron oxide, which is evidently an altered pyrite. It is also a significant fact that most of the gold obtained along this line has been from the surface, and not from well defined gravel beds, as they are usually called. Indeed, the accumulations from the process of washing consist of angular quartz fragments, slate, and staurolite. By collating these facts, and reasoning from them as the best data at my command, I have settled down in the conviction that the staurolite slate here mentioned is the source of the gold found in this belt of placer mines. I must, however, state another fact, which may be of

interest. At one point in this belt there was discovered, some years ago, an apparent laminated quartz vein, bearing gold. It is questionable, however, as to this being a vein in the proper sense of the term. Is it not more likely to be an intercalated wedge of quartz, or more properly speaking, an integral part of the slate. I have seen similar wedge-shaped masses at other localities, which proved to be nothing more than intercalations and segregations, as part of the sediments of which the slate is composed. I believe gold often occurs as a sediment; that is, I mean to say that it was formed into scales and grains, and as such was deposited with the other elements which make the slates. By manipulating slates I have obtained such rounded particles which occupied no other place in the slate than one of its sedimentary parts. Now, whether the gold belonging to this staurolite slate was deposited as free gold with the slaty elements, or existed originally in an iron sulphuret, I have no positive information, having never tested these slates, as I did others in Georgia many years ago. Be this as it may, I have scarcely a doubt that the chief part of the gold in the placers under consideration has come from these staurolite slates. This belt is worthy of further and more careful research and investigation. The largest nuggets found in this Valley-river zone have ranged from fifteen to thirty pennyweights. This zone passes in a southwest direction into Georgia, and in it is the White Path Mine, which, in earlier times, yielded a large amount of gold.

On the south, and much nearer towards the summit of the Blue Ridge, there is a belt of micaceous and talco-micaceous schists which belong to the transition rocks, that are gold-bearing. This is known in that district as the Gumlog and Brasstown belt. The occurrence of gold in this zone is more distinctively in quartz veins. Indeed, gold-bearing quartz veins are numerous, beginning with those near Blairsville, in Union County, Georgia, and passing down Gumlog Creek and crossing Brasstown into Clay County, North Carolina, and continuing northeast up Tesquittee Creek. I have not examined the slates thoroughly that line the veins, but I have no knowledge that any gold has ever been found in them. So far as my observation extends, the probabilities are strong that there are reliable gold veins in this zone. At one of the localities on Gumlog, the quartz vein carries sphalerite (blende) and galena, as well as gold. The gold in the veins of this belt occurs with iron pyrite. All these veins, however, have undergone those atmospheric alterations which have resulted in the oxidation of the sulphurets in their upper parts, so that free milling ores are obtained towards the surface. The value, however, of these veins is unknown, for there has never been made a fair test of any vein, as to its extent and persistency, on the whole length of the outcrops—a distance of about thirty miles. The best and richest ores in the Gumlog section were picked up during the war by the people living near the locality, and partially crushed by hand in small iron mortars for the gold they would yield. Nor was this, under the circumstances, so trivial a matter as might be supposed. I found detached ores upon the surface that a good panner could crush in a hand mortar, and make his pennyweight of gold per day. As suggested above, the surface was stripped of those rich specimens, and scarcely anything can now be seen. That district, however, is an inviting one for research, investment, and enterprise. Should it fall into skillful hands and be subjected to intelligent management and the improved methods for saving gold now in use, I have no doubt it will be numbered amongst the prosperous mining districts of the country.

I now turn to another field, which is larger in its proportions and of much greater extent every way. There is a zone lying on the south of the axis of upheaval (the Blue Ridge mass) that extends from Alabama through Georgia, South Carolina, North Carolina, and into Virginia. It is ramified through its entire length with gold-bearing rocks, and varies in width, at least apparently so, if judged by the outcrops and developments. I traversed it some years ago, from South Carolina to Alabama, and having experimented with and studied the lithological relations and habits of the gold-bearing rocks, I obtained some information and suggested some theories regarding the sources and mode of occurrence of the gold, which may perhaps be interesting to those who may be prosecuting researches in that direction. It has afforded me some pleasure to know that some of my opinions have been verified by subsequent developments.

Inasmuch as I located the first point for hydraulic hose works in Georgia, I will confine myself in the succeeding statements mainly to that section. Micaceous and chloritic slates occupy the center of the Nacoochee and Dahlonega belt, though there are occasional interfoliations of talco-micaceous shales. Some of the veins are walled on one side with a variety of gneiss, and on the other with one or the other of the slates just mentioned. What was known twenty-five years ago as the White & McGee vein, in the Nacoochee District, is an example in point. This vein, as I saw it, had a central quartz axis, the quartz being laid down in jointed blocks, after the order of bricks laid one upon another.

While the quartz did not contain gold in itself proper, I found grains of gold in a soft hydrated manganese which often formed layers between the quartz blocks as thick as a knife blade. There was nothing here to entitle it to the name of a vein. The walling of this narrow quartz zone on one side was a sort of fine grained gniess rendered friable by partial decomposition. The wall on the other side consisted of a chloritic or micaceous shale rendered also soft and friable. The gold was found to exist in these wallings, and the whole mass was taken for some eight or ten feet wide and crushed. In my examination I did not find any sulphurets and indeed but little evidence that any existed in the rocks that were crushed. Somewhere in the forties, Col. Reynolds, with a small but rude mill, realized from this gold channel, as it should be called, 37,000 pennyweights of gold of high grade in one year. In the same neighborhood, on what was then known as the Eng-

land lot, there was a quartz vein from four to six feet thick and standing nearly perpendicular. The pioneer miners had dug pits upon it at different points for half a mile, and no doubt tested the quartz for gold, and not finding any had abandoned the search. It lay in this condition for quite a number of years, but finally falling into the hands of Mr. J. R. Dean, Jr., he turned the waters of his canal upon this property and hosed out the whole ravine below, which had been rich and pretty well worked over. Reaching the quartz vein he found it inclosed in an arenaceous mica shale. This shale on either side contained some iron oxide, evidently the result of altered pyrite. These linings of the vein were very rich in gold. A large per cent of them yielded to hose, while other portions more quartzose and of course less friable were laid aside for stamp work. Singular as it may seem to most gold miners, Mr. Dean tried a great many experiments with the quartz but never did he find so much as a particle of gold in it. Indeed, it bore no evidence of mineralization and was utterly barren in the precious metal. The facts developed at these two mines exploded the theory that quartz only carried gold. I had, after numerous experiments, advanced the conjecture that the slates and shales of the district carried more gold than the quartz ledges or veins, and this conjecture was verified, at least, in these instances. How far these slates and shales may have been mineralized by iron pyrites, and with what tenacity gold adheres to that mineral in its occurrence, I will not, with the present evidence, undertake to say. But I will say that the facts I have stated are suggestive and should lead to more thorough investigation of the question. I have no doubt that much valuable stamp material was rejected by the early miners as worthless slates and mere wallings of the gold-bearing quartz. Had I been in other circumstances I would ere this have been in possession of additional and perhaps valuable facts touching this question.

In the same (the Nacoochee District) I have a few facts to state in regard to placer mining. As early as 1856 I discovered a system of granite dykes passing through the gold-bearing belt. I observed certain points at which the old miners testified that large nuggets had been found. I had come to the conclusion that, in the earth's laboratory, gold is often held in solution, and reasoning from these standpoints I advanced the theory that the heat and chemical conditions produced by these dykes had a good deal to do in the deposition and crystallization of the gold into large nuggets. Now as to the feasibility of my theory, I shall rely upon the facts subsequently developed. There was a point in a narrow ravine three or four hundred yards from the White & McGee vein, and on a different range, where nuggets weighing from 50 to 60 pennyweights had been found, as the old miners alleged. First, Mr. Dean, at my suggestion, turned the water down there and sluiced off the point of the ridge, finding quite a number of nuggets in the red clay of the hillside, one of which weighed 387 pennyweights. Afterwards he hosed out the ravine which had once been worked over, commencing at the creek and continuing up to the point where the coarse gold and nuggets had been found. Here he uncovered a granite dyke, above and away from which no gold was found. This convinced him that there was something in the theory I had suggested. After the close of the war Mr. Dean was succeeded by Captain Bosworth as Superintendent of the mines. Taking the hint from former results, he continued the canal so as to enable him to hose out a dry hollow, including the head of the Richardson branch. Here he worked a whole Summer, taking up 33,000 pennyweights of gold, some nuggets weighing as much as 400 pennyweights. The foreman of the hose company which did this work told me that at the extreme head of this hollow they struck and uncovered one of those narrow granite dykes, and that above and beyond it they did not find any gold.

At old Captain Richardson's residence, down the creek, a granite dyke trended immediately by the house and diagonally along the hillside. Below the house and garden there is a flat dropping off suddenly to the creek bottom. Around and on this descent there was a coarse gravel bed very rich in gold, which was worked over during the first mining operations in that section. I often urged Captain Richardson to have the flat where his garden and stables were located worked out, but he persistently declined to do so. Since his death his grandsons worked over that ground and quite up to the house and near the dyke. They obtained a fine lot of gold, amongst which were some large and singularly shaped nuggets. One of these was very interesting indeed, having the shape of a fish, somewhat like those found amongst the earliest vertebrates. Then, again, sixteen or eighteen miles northeast on the range, is what was known as the Shelton Mine, on Soquel River. This was worked at an early period, and one mass of gold found that weighed three pounds. Subsequent work uncovered a granite dyke, and upon the back of this dyke an 18-pennyweight nugget was found, to which and in which fragments of feldspar were observed, as though the gold had been crystallized in contact with the granite.

In conclusion, upon this point, let me say, that it is a significant fact that in all this work at the four localities, work carried down to the bedrock, there were no quartz veins discovered. So it is evident that these large nuggets did not come from quartz ledges, unless we adopt the theory that the ledges were shallow and were entirely broken down and swept away. In that case, the force necessary to have removed the large masses of the veins would have certainly carried away, at least, the finer gold, which was not the case, as it yet remains in the gravel beds of the lower sections of the drainage area, and in the surface. Indeed, the further from the dyke the smaller the gold is, showing that the drift forces have been moderate. However this gold may have been formed, and whatever may have been its original source or conditions, these facts just stated are suggestive, and are worthy of thought by all who are in any way interested as scientists or miners.

I am apprised of the reluctance with which men abandon old theories. Some author of profound erudition in his branch puts forth a theory, and thousands embrace it, and believe that he was incapable of committing a mistake. His theory was perhaps the best that could be given with the lights before him. I believe, nevertheless, that no one is really fit to be a mineralogist or geologist who goes into the field of scientific research wearing straight jackets, be the pattern new or old. It requires an untrammeled brain to arrive at truth.

As there is great similarity in the gold-bearing rocks of the whole zone, from Alabama to Virginia, I will let this discussion of the points mentioned, with which I am most familiar, speak for the whole. I do not undertake to say that the same conditions which I have described exist at every locality. Nor can other localities require those I have discussed to conform to their peculiarities. If, however, the facts and suggestions put forth in this paper shall lead to the discovery of any great truth, or shall result in any discovery in the field of practical mining, of general benefit, I shall have my reward.

On his return to his own State, Mr. Smith sent me some specimens of gold, from a new discovery in Transylvania County, which I examined with the following results:

The gold was of a deep color, bright, and free from coating, and was more than semi-crystalline. Some pieces showed a tendency to assume the form of threads, on which indistinct octahedral crystals were strung like beads—a form not uncommon in California. A few particles were pale colored as if touched with mercury or alloyed with silver (electrum).

The test assay was made by panning, collecting the gold prospect, and weighing.

The percentage of gold was .01, one part of gold in 10,000 parts of quartz.

Ounces per ton of 2,000 pounds	2.91+
Value per ton of 2,000 pounds	$60 28

The residue left with the gold in panning showed, under the microscope, transparent quartz and particles of hematite and limonite, but no crystals or pyritic matter.

The quartz from which the gold was washed was partly white and crystalline granular, resembling loaf sugar, and almost as easily crushed; partly like alabaster or very fine grained dolomite, but the larger portion was very ferruginous, being mixed with ochery matter, which was found to be limonite. Although this oxide is probably the result of change from pyrite, there is nothing left to show how this change took place, all traces of the original mineral being lost.

The following letter, in reply to one of inquiry from me, contains valuable information regarding the manner of working, yield, and cost of gold mining in North Carolina. I much regret I could not visit the gold mines of this State:

Hoover Hill, Randolph County, N. C., May 14, 1885.

Henry G. Hanks, Esq., New Orleans:

Dear Sir: I have received your letter of twenty-eighth ultimo, and am sorry you will not visit this neighborhood.

The following are answers to the questions you ask:

Capital—Foreign (London), 120,000 shares of 10 shillings each.

Stamps—Twenty.

Yield per ton—In 1884, $6 13. Yield per ton for four months ending April 30, 1885, $10 84 per ton.

Fineness of bullion—Say, 780 gold and 210 silver.

Prospective workings—Mine is being opened out vigorously by sinking and drifting. One shaft is down 250 feet, and another about a quarter of a mile distant, 140 feet.

Labor—Both colored and white employed in the mine in about equal numbers; all engineers and carpenters are white. Both colored and white blacksmiths are employed; the mill hands are all white. Common laborers get 75 cents per day of 10 hours, strikers 80 to 90 cents, miners $1 25 to $1 35, carpenters $1 25 to $1 50, blacksmiths $1 50, engineers (12 hours) $1. Picked colored labor in the mine is fairly satisfactory.

The company has just declared an interim dividend for six months ending April thirtieth, at the rate of 5 per cent per annum, 3 pence per share.

Yours respectfully,

WM. FRECHEVILLE.

Besides gold, North Carolina is rich in other minerals. Coal is found, but it is not as yet important. The following economic minerals occur in the State: *agate; agalmatolite*, from a large deposit called soapstone, used in a large way by manufacturers of wall papers, also in soaps, cosmetics, and for adulterations; asbestus; barite; *building stones; chromic iron*, found in considerable quantity; *corundum*, found in abundance and used in the manufacture of emery—one crystal now in the museum of Amherst College, in Massachusetts, weighs 312 pounds; diamonds—several have been found in the State; *graphite; grindstone grits*; *kaolin* and clays, quite abundant; *limestones; limonite; marbles*, many beautiful varieties; *marls*, very abundant and important; *mica*, in coarse granite. This mineral is mined in six counties. One deposit in Mitchell County yields one ton of merchantable mica per month; pyrite, sometimes auriferous, suitable for the making of sulphuric acid; *pyrolusite*, binoxide of manganese; *serpentine; copper ores* are found in many localities in the State, generally associated with auriferous ores. The principal mines, or those which give the most promise of prospective value, are in Guilford and Ashe Counties.

The mineral exhibit of North Carolina was specially fine; some remarkably beautiful and rare specimens were shown. The collection was under the charge of William Earl Hidden and C. D. Smith, both of whom have furnished papers for this report. I am much indebted to them, also, for valuable verbal information. The choicest specimens were arranged in plate-glass cases, placed under and about a central dome or kiosk, covered and resplendent with plates of mica. The rarest and most interesting of these are described in the following paper:

SPECIAL PAPER BY WM. EARL HIDDEN, ON THE MINERALS OF NORTH CAROLINA EXHIBITED IN THE GOVERNMENT BUILDING.

AUGUST 21, 1885.

In the North Carolina section the minerals of special merit were numerous. Noteworthy were the gems and precious stones in their natural and cut shapes. Of minerals of scientific interest more than one hundred and fifty species were exhibited. Here appended the reader will find enumerated the specialties shown by this one State:

Native Gold.—Over $5,000 in value in nuggets from various counties in the middle and western section of the State. One nugget from Montgomery County weighed four and one half pounds (4½ pounds).

Tetradymite (bismuth telluride).—From Davidson County, with gold.

Altaite (lead, etc., telluride).—From Kings Mountain, in calcite with gold.

Barnhardite (46 per cent copper).—From Cabarras and other counties.

Ferrous-chloride (stagmatite, Lawrencite).—In the Rockingham County meteoric iron.

Corundum.—In crystals and masses of varied color from many counties. From Macon County a series of gems, *i. e.*, the ruby, oriental topaz, oriental emerald, sapphire, and asteria, from the famous "Jencks Mine." Single crystals of many hundred dollars value were found there some ten years since. Massive pink corundum from Clay County was shown in quite large plates that were translucent.

Gahnite (zinc spinel).—Dark green crystalline masses, having great hardness, were shown from Mitchell County. They contained 38 per cent zinc.

Uraninite (uranium oxide).—Large masses of this rare mineral found in Mitchell County, and having a density of about 9. Color, magnetite-black.

Rutile (titanium oxide).—This is one of the species in which North Carolina stands preëminent as furnishing the finest crystallizations yet known, those from Alexander County being the best prisms of the highest luster of one to three inches in length, geniculated and beautifully terminated with many planes. By transmitted light they had a fine ruby-silver color.

QUARTZ.—In particular, the exhibit of quartz crystals was very interesting and complete. Nearly all the known forms were shown. A series of rare forms such as Professor Gerhard vom Rath has described recently in "Zeitschrift für Krystallographie und Mineralogie," were of uncommon interest. He writes, "These crystals from Alexander County surpass all others in interest, since they possess all the remarkable features shown by other localities." Fluid-bearing crystals with moving bubbles of large size, and crystals and masses containing rutile (fleche d' amour) in golden needles, were also shown. A crystal ball, limpid and perfect, was exhibited from Alexander County. It was cut in Newark, New Jersey. It measured 2¼ inches in diameter.

Spodumene.—Clear yellowish-green crystals and the rare emerald-green variety, *i. e.*, *hiddenite*, were shown as cut gems and as natural crystals. Of the latter, it is necessary to state that it has obtained a value of $100 per carat and upwards and vies with the emerald in beauty and brilliancy. It has only been found in Miller's Township, Alexander County, North Carolina.

Beryl.—Pale bluish and greenish crystals, weighing from a few ounces to those of over forty pounds, were noticed. In the gem line, were yellow, blue, and green tinted stones of great brilliancy. These latter came from Mitchell, Yancy, Macon, and Alexander Counties; mostly in the mica mines. Resembling the fine productions from Siberia, were a few transparent prisms from Alexander County of remarkable crystallographic interest; one in particular, which, in its uncut state, was as brilliant as a gem, and had over forty planes in its termination, and had twelve sides. Quite unprecedented for American localities, was the exhibit of emeralds discovered in the Hiddenite Mine, in Alexander County. Noteworthy is the extraordinary size of some of the emeralds found at this mine—one measured 8½ inches long, and weighed nine ounces; another was 5 inches long; one measures 3½ inches, and is very clear. For three emerald crystals from this mine, sold in their rough state, $1,250 was paid by an American collector who wished to retain them in their natural condition as crystals.

Zircon.—Many pounds of large crystals from Henderson County, which locality furnished 1,800 pounds in one year. From Burke County a few brilliant and highly modified crystals of perfect transparency, and of various tints of brown, pink, yellow, and purple.

Epidote.—Fine crystals (implanted), from Yancy County.

Allanite.—A variety rich in yttrium, from Mitchell County; found with samarskite.

Muscovite (mica).—The wonderful exhibit of this mineral, from this State, will long be remembered. The dazzling pavilion covered with this mineral was ample evidence of the wealth of North Carolina in mica. The yearly outputs are calculated to reach $150,000 in this State alone. Sheets uncut and cut were shown in special cases, of from six inches to twenty inches square, with a few exceptional crystals of nearly two and a half feet in diameter.

Orthoclase (feldspar).—One large crystal of about forty pounds weight.

Albite.—Two groups of finely-twined (parallel to the base) and brilliant crystals from Alexander County.

Samarskite.—Until found in North Carolina one of the very rarest of minerals. Over 1,000 pounds in irregular masses were taken out of the Wiseman Mica Mine, in Mitchell County, at one time, since which remarkable discovery very little more has been found. It contains thirteen or more rare elements, among which are columbium, tantalum, uranium, cerium, yttrium, phillipium, and decipium.

Of Rare Minerals.—Fine specimens were shown of columbite, tantalite, gummite, uraninite, hatchettolite, and fergusonite.

Xenotime.—Fine crystals from Burke County, Mills' Mine.

Monazite.—Remarkably large and brilliant crystals from Alexander County.

Apatite (phosphate of lime).—Clear transparent crystals from Alexander County, and large opaque ones from Yancy County.

Pyromorphite (phosphate of lead).—Fine crystallizations of a green color, from Davidson County.

Dolomite.—Clear crystals implanted on gneiss, associated with quartz, rutile, mica, and apatite crystals. Alexander County.

Siderite.—Brown translucent crystals, similar to last.

Cerussite.—Fine crystallizations, from Silver Hill Mine, in Davidson County.

The mineral, hiddenite, mentioned in the above paper, was specially beautiful and attracted much attention. The following extracts from a New Orleans paper, contain more information concerning it:

For the benefit of those interested we subjoin a few facts gathered from a conversation with Mr. William Earl Hidden, the discoverer of the hiddenite. Hiddenite was unknown prior to February, 1881. It received its name from Dr. J. Lawrence Smith (now deceased), of Louisville, Ky., who was the first to recognize its true chemical nature, and finding it new, gave it its name in honor to the discoverer.

It seems that the discovery was of the nature of a scientific deduction, somewhat like that of Humboldt's regarding diamonds in the Urals. Mr. Hidden, who was carrying forward a systematic search for platinum through the Southern States, under the patronage of the famous Thomas A. Edison, came across, in Alexander County, North Carolina, a few pieces of beryl, which in their edges showed a tinge of color which verged distinctly on that of the emerald. On this observation he formed the following hypothesis, *i. e.*, that a region which could produce beryls having a slight tint of the true emerald color, might, or ought to, furnish the *pure emerald*, if proper search was made for them. Accordingly, at his first leisure he revisited the locality and commenced a systematic search for the *source* of the crystals of beryl which up to that time had only been found loose in the surface soil. After five weeks of fruitless effort, a vein was found at a depth of eight feet below the surface, in which he not only found the true emerald he had been seeking for, but along with it many slender crystals having emerald color, but totally different in all other respects from the emerald proper. It was to these slender crystals that later were given the name hiddenite.

Possessing, as they did, all the requirements of a gemstone, *i. e.*, hardness, beauty, rarity, and brilliancy, it was not long before the merits of the new found gem was appreciated by the jewelers and the *dilettanti*, and a lively competition sprang up for their possession. Almost at once sales were made at the high rate of $100 per carat, and within a year after the discovery the gem had been successfully introduced in the gem marts at home and abroad as one of the highest rank.

To-day it is the very rarest among the precious stones; fewer of them exist as far as known, and virtually none are now for sale. The stones have usually been spoken for—ordered—long before they were found, such is the demand for them.

Hiddenite is everywhere confessed, when in its best shades, to have a livelier and more brilliant color than the emerald. No less an authority than Prof. Dana writes in the last appendix to his invaluable system of mineralogy that "hiddenite is highly valued as gems, and in consequence of its pleochroism (many colors) has a peculiar brilliancy which is lacking in the true emerald."

A fact of probable interest is that all the work done at the mine, situated in Alexander County, has been more than repaid by the sales of gems found.

Besides the central collection, ores and economic minerals were shown elsewhere in quantities, among which I noticed the following: *coal; coprolites; copper ores* and *shales*, suitable for leaching; *copper ingots; gold quartz*, resembling the ores of California; *iron ores*, and pig iron, from various localities and furnaces; *tin ore*, and stream tin, from Cleveland County; *rocks and building stones*, including marbles, in a number of varieties, some very fine; *leopardite*, some very large and fine specimens. A leopard was shown sculptured from this rock. Blocks were also shown of dendritic and mottled varieties; *furnace-hearth fire-proof stone; glass sand; shell rock; itacolumite*, very flexible and fine. One of the most interesting specimens of this group was a fine monolith 19 feet long, finely chiseled, and resting on short pillars of the same fine grained granite. It was from the Anderson granite quarries.

Of economic minerals not mentioned in Mr. Hidden's paper, there were shown: *barite*, very fine; *chalcosite; chalcopyrite*, in large masses, very fine; *chrysocolla; galena*, some specimens resembling the argentiferous galena from Deer Island, Maine; *garnets*, of extraordinary size, some being 4 inches in diameter; *limonite*, after siderite, very fine; *meteorite*, a small iron with section showing Widmanstattian figures; *pyrite* in crystals, very fine; *serpentine*, mottled variety; *siderite* in quartz, and in fine crystals; *staurolite crystals; steatite; sun stone*, fine; *the Hendricks gem*, a magnificent topaz, found in 1879 in Burke County. It is large and perfect; cut as a rose brilliant.

OHIO.

State, November 29, 1802. Area, 39,964 square miles. Population in 1880, 3,198,062. Capital, Columbus. Floor space in Exposition, 6,700 square feet. State divided into 88 counties. The surface is diversified with hill land, and plateau lands having an elevation of 300 to 1,060 feet above the sea. The highest land (1,540 feet) is in Logan County.

The principal minerals found in the State are coal, iron, clay, gypsum, peat, salt, petroleum, lime, hydraulic cement, marls, and building stones. Coal is the great mineral staple of the State. The coal fields cover an area of 10,000 square miles.

The grand collective exhibit was made officially by the State. The mineral section contained numerous fine specimens, many of them being shown in large quantities.

The general exhibit of the State Geological Survey was specially fine; no catalogue could be obtained containing the names and showing classification of the specimens.

A relief map of Ohio was brought to the Exposition as late as the middle of May. It was built up of plaster of Paris by Wyndham C. Jones, C.E.,

of Cleveland. The horizontal scale was 4 miles to one inch, and the vertical scale 300 feet to an inch. It was constructed from 2,000 altitudes. This map was very well made and was both instructive and interesting.

Coal was shown in large masses or blocks and sections of veins or seams. One, the "big vein," Randall, Perry County, seemed to be from 12 to 14 feet thick. Fine samples of coke were also shown. Pig iron, too, was displayed in large quantities.

Fine samples of gypsum were on exhibit. This mineral is extensively utilized in the State.

The display of the manufacture of clays was also very fine. The most interesting object was a glassmaker's pot, made from Ohio clay. There were also fine garden vases, tiles, fire-brick, pressed brick, ornamental tiles, pottery, roofing tiles, and common and refractory clays.

A prominent object in the Ohio mineral exhibit was a pile of grindstones rising like a monument many feet high. The lower stone was 7 feet in diameter and the upper small one was only 5 inches.

In the Geological Survey collection there were many building stones in cubes, including all the best in the State.

The archæological exhibit made by Ohio was very fine. It represented relics of the stone age and the mound building period. The collection contained many if not all the fine specimens shown at the Centennial Exposition and described and figured in the "*Final Report of the Ohio State Board of Centennial Managers to the General Assembly of the State of Ohio. 1877.*"

OREGON.

Territory, August 14, 1848. State, February 14, 1859. Area, 95,244 square miles. Population in 1880, 174,768. Capital, Salem. Floor space at the Exposition, 3,325 square feet. The State is divided into 23 counties. Oregon is divided into two unequal parts, Eastern and Western Oregon, by the Cascade Mountains, which rise to a heighth of from 4,000 to 10,000 feet; a few peaks are still higher. The summit of Mount Hood is 11,934 feet above sea level.

Besides the mountains mentioned, there is a coast range running nearly parallel to and about 25 miles distant from the seacoast. Some of the summits of this range are from 1,000 to 4,000 feet high. The principal minerals in Oregon, as far as discovered, are gold, silver, copper, and nickel ores. Lignite, good building stones, including limestones, granite, syenite, slates, sandstones, and marbles, salt springs, mineral waters, steatite, clays, pottery, and brick material, etc.

The collective exhibit made by Oregon was not large, but was creditable to the State.

The mineral exhibit was also small, but contained a number of interesting and even remarkable specimens. The State is indebted to Mr. J. W. Virtue for special work and for fine specimens loaned from his private cabinet. The mineral exhibit consisted of ores, minerals, rocks, building materials, etc., in table cases, and larger specimens on tables uncovered. The State made an appropriation and appointed Mr. Virtue Special Mineral Commissioner.

The counties in Oregon which are considered and designated *mineral counties*, are Baker, Grant, and Union. Gold and silver have been largely produced.

To June 30, 1883, precious metals from Oregon were deposited in the Mints of the United States as follows:

Gold	$17,392,549 36
Silver	46,391 05
	$17,438,940 41

The following estimates of the annual production of the precious metals combined, are from reports of the Superintendent of the Mint, and from those of R. W. Raymond:

1874	$609,070 00
1875	1,665,000 00
1876	1,601,000 00
1878	1,100,000 00
1879	1,170,000 00
1880	1,105,000 00
1881	1,140,000 00
1882	865,000 00
1883	680,000 00
	$9,935,070 00

Before 1874, the bullion product of Oregon and Washington was estimated in aggregate.

In the Oregon mineral exhibit the following special specimens were noticed and examined:

Gold nuggets.—From near Baker City, taken from gravel claims 10 to 117 feet thick. Hydraulic mining is in active operation at the locality. *Coarse gold nuggets*, from the Nelson Hydraulic Claim, from which $40,000 worth has already been taken out.

Cinnabar.—Grant County—float. The vein has never been found.

Hematite.—Baker City. Fine.

Fine grained galena.—Sparta Mine, Union County.

Limonite.—Oswego Iron Works. Pig iron was shown made from this ore.

Of ores, there were shown:

Rich gold quartz.—From Connor Creek, and from the Virtue Mine, Baker County. This is free milling ore. The gold obtained is 925 fine.

Silver lead ore.—From the Garfield Mine, head of Powder River, Baker County. Specimens from the *Monumental Mine*, Eastern Oregon. The ore contains gold and silver; the bullion product is worth from $9 to $11 per ounce.

Pyritic ore.—Westfield Mine, Grant County.

PENNSYLVANIA.

One of the original thirteen States. Area, 46,000 square miles. Population in 1880, 4,282,891. Capital, Harrisburg. Floor space at Exposition, 5,400 square feet. State divided into 66 counties. Pennsylvania is the second State in population and wealth in the Union. The southeastern part of the State is generally level. The central portion is mountainous. The most important chain of mountains is the Alleghany, from the summits of which the lands slope towards the State of Ohio.

The principal minerals of economic value found in Pennsylvania are coal, iron, petroleum, building stones, copper, chromic iron, zinc, and a few others of minor importance.

The area of the coal fields of this State is 12,774 square miles.

The total petroleum production from 1859 to 1882 inclusive, was 209,-028,000 barrels of 42 gallons.

The total mineral products of Pennsylvania for the year 1870 amounted to $76,208,390.

Pennsylvania is very abundantly supplied with fuels, for which reason

she is one of the greatest, if not *the* greatest manufacturing State of the Union. Within a few years natural inflammable gas has been added to the list, and the new fuel seems to be cheaper than even petroleum. As there are a few accidental gas wells in California, and a probability of other sources being found by prospecting for, I have thought best to give the following paper on that subject in full:

From "The Mercantile, Manufacturing, and Mining Interests of Pittsburgh." Issued by the Chamber of Commerce, 1884.

NATURAL GAS.

SUBSTITUTION OF NATURAL GAS FOR COAL—ECONOMY AND WIDE UTILITY—THE NATURE AND EXTENT OF SUPPLY.

This report would fail of its intent and purpose if it did not take cognizance of the marvelous store of caloric and dynamic agency, recently so profusely brought forth by drilling in and around Pittsburgh. Though natural gas has been found for many years back in Western Pennsylvania, in boring for salt water and petroleum, its value as a means of generating heat and power has only been recognized within a comparatively short time. The extreme wastefulness with which the petroleum resources of this region have been drawn upon, owing to the apparently insurmountable difficulty of limiting production to such a degree as would correspond to consumption, now bids fair to be repeated in the more rarified fluid under discussion. The chief factor by which it is distinguished, in an economical sense, from petroleum, is that natural gas cannot be transported so readily for long distances as petroleum. While the latter has the whole civilized and semi-civilized world for a market, the former can only be conveyed a limited distance by means of pipes.

Friction and technical difficulties make it quite certain that the consumption of natural gas will be confined to within very narrow limits of its native place, and it is apparent that the substitution of natural gas for coal in our industries, will give Pittsburgh such a commanding position in manufactures, as will secure to her far more widely expanded markets than she formerly possessed.

The general introduction of natural gas as a fuel, has been retarded by certain legal proceedings involving corporate rights; and secondly, by the delay due to the passage of a municipal ordinance. In the meantime drilling for gas had received such a stimulus by the success obtained in the first ventures, that hundreds of derricks were erected within the city limits and immediate proximity, by the middle of the Summer of 1884. The producing wells number already a score, and the abundant supply of gas is now an assured fact, beyond the possibility of doubt.

An entire or absolute substitution of gas for coal is not likely to occur, but so much is certain, that "Smoky City," by which Pittsburgh has been familiarly known to three generations, will, in the near future, become a misnomer. The consumption of coal, locally, has been over three millions of tons per annum. This amount, according to reasonable estimate, will be reduced to one half, or even one third. The equivalent of five thousand tons of coal per day, may be supplied by a dozen gas wells, or even less. A single well has furnished gas equal to twelve hundred tons of coal per day. The peculiar competitive features of petroleum and natural gas wells, noted at the outset, obtain in full force, and will cause the price of fuel, so long as the supply lasts, to be at a minimum. There are at least thirty thousand real estate owners in Alleghany County and adjoining, every one of which enjoys the prospect of finding gas on his own ground by boring a six-inch hole, the cost of doing so being only from three to four thousand dollars.

It is by no means a sanguine view to say that Pittsburgh will save from two to three millions of dollars annually by the subtle fuel, besides the great advantage in many lines of manufacture that, by reason of its absolute purity, and the perfect control of the process of combustion, the product is not only cheapened but also improved.

There is still another valuable quality in natural gas, which, strange to say, has been largely overlooked. The pressure of hundreds of pounds per square inch, with which the gas issues forth, furnishes in itself a source of power of surprising extent, economy, and convenience. Calorific consumption requires that this pressure should be reduced to one or two per cent of its original amount, and the other may be utilized in dynamic devices of various kinds, and the value of the gas still remain unimpaired, or rather it may be left in a form exactly adapted to burning. In fact, it may not be altogether fanciful to look forward to the day when the same service pipe shall deliver power and heat as well as light.

The world has for a long time been wanting a motor for domestic use and light manufacturing purposes, and by the means indicated thousands of pneumatic engines for running lathes, sewing machines, elevators, etc., may be introduced here, not only lightening the labors of the household, but establishing diversified and lucrative employment for tens of thousands. The minor industries that generally cluster around the primary forms of production, are still in a very undeveloped state in our city, and it is much to be desired that they should be fostered here for reasons that will suggest themselves.

Natural gas and its uses have received such tardy recognition that the whole field of inquiry is practically unexplored. There is no literature on the subject, hence this paper

may in general terms at least present the salient features and the latest and most authentic information obtainable on the subject. In so doing we avail ourselves of the report of a special committee appointed by the Engineers Society of Pittsburgh, which committee devoted several months of research and inquiry to the subject of natural gas, and presented the results of its labors at a meeting held in May last.

Natural gas from western Pennsylvania is, in most cases, a mixture of more or less complex character. The few investigations published during the past few years tend to show that it is essentially composed of the hydro-carbons of the series known in chemistry as paraffines.

The members differ in their relative proportions of carbon and hydrogen. The vapors of these hydrocarbons are heavier as the proportion of carbon is greater. The calorific values show the superiority of marsh gas, weight for weight, over all the others. Some are odorless; among the others the odor is stronger in proportion as the amount of carbon is greater. A remarkable similarity of chemical properties is exhibited by all, and by reason of the strong attraction existing between them, the boiling point of a mixture is always found to be considerably higher than that of its most volatile constituent. They are theoretically the point of departure for the formation of a great number of useful compounds, such as alcohol, chloroform, acetic acid, and glycerine, but on account of serious technical difficulties, due chiefly to their remarkable resistance to ordinary chemical reagents (paraffin, parum and affinis), they have never yet been turned to practical account. They are not actively poisonous.

In the lower sand rocks of the oil regions occur probably all the members of the series, the less volatile flowing as petroleum and the more volatile existing in a state of compression, ready to escape through every opening.

Natural gas is, then, a mixture of the most volatile of these hydrocarbons, carrying various quantities of the vapor of the less volatile compounds. The lightest member, marsh gas (so called from its constant occurrence among the products of vegetable decay), is the chief element of the gas supplied to Pittsburgh. In addition to these, hydrogen, carbonic acid, carbonic oxide, oxygen, and nitrogen are found.

As the gas and oil sands all have a slight dip towards the southwest the gas in the southern part of the region is drawn from rock strata which are higher in the geological series than those yielding the gas in northern Pennsylvania and New York State. If any attempt at a generalization may be made with the few data at disposal, it appears, therefore, that the deeper strata yield, in general, a gas of higher specific gravity and illuminating power.

Analytical data covering a greater area of gas producing territory may in the future throw important light on the interesting question of the origin of gas and oil. The theory which traces both to the seaweed of the ancient Devonian sea, which once covered western Pennsylvania, has been very generally popular. Exhalations of combustible gas have been frequently met with in other countries, though nowhere in quantity comparable with the prodigious outflow from the gas wells of western Pennsylvania. Wells drilled for natural gas, outside of the oil regions, are of recent date, with a few exceptions. The wells at New Cumberland, West Virginia, have supplied gas for more than twenty years for the manufacture of bricks. The East Liverpool wells have been burning twenty-five years and are still productive. At Beaver Falls natural gas has been used for six years in a cutlery works, but lately the gas has failed, presumably on account of the wells becoming filled up, either with paraffine wax in the pores of the rock, or with an incrustation of lime and magnesia, as it is said they have never been cleaned out since they were drilled. At Erie so many wells have been drilled to the stratum of gas rock that it has become partially exhausted. In the oil regions a gas well was looked on rather as a curse than a blessing, and as most of the wells produce gas as well as oil, and so many were drilled to the same sand or rock, it soon exhausted the supply.

Besides the several wells that have been found within the municipal limits of Pittsburgh and Allegheny City within the last few months, our city has the advantage of being able to tap three or four gas belts or fields: The Butler County field, which supplies Spang, Chalfant & Co.; the Bull Creek or Tarentum field, which struck gas at 1,147 feet depth, and supplies the Pittsburgh Plate Glass Company, Pennsylvania Salt Manufacturing Company, and will supply Richards & Hartley's and Challinor & Taylor's new glass houses, and Godfrey & Clark's new paper mill; the Murraysville or Turtle Creek and Lyons Run field, which tapped the gas at 1,337 feet depth and supplies the gas for the Acme Gas Company, used by the Edgar Thomson Steel Works; the Fuel Gas Company, who furnish gas to the several mills and glass houses on the South Side; the Penn Fuel Company, who furnish the Union Iron Mills, Park Brothers & Co., limited, Wilson, Walker & Co., Hussey, Howe & Co., Shoenberger & Co., and many other works in the same neighborhood on the Allegheny River; the belt or field in Washington County, in which is the celebrated McGuigan well, the gas from which is being piped to the South Side. No doubt other prolific fields will be found to produce gas in the near future.

The more durable wells tap the gas productive strata generally at a greater depth than a thousand feet. It is a common opinion among those versed in the management of gas wells, that the outflow is subject to a gradual diminution, tending ultimately to total extinction. Evidence of this is to be found in all parts of the gas territory, where gas wells have been long in use. In many localities, however, there is reason to think that the gradual falling off of the supply of a well is due to the choking up of the pipe by a deposit of salt or paraffin, rather than to the failure of the original source. This is notably the case with the Freeport gas wells.

Natural gas, next to hydrogen, is the most powerful of the gaseous fuels, and if properly applied, one of the most economical, as very nearly its theoretical heating power can be utilized. It is used for almost all the purposes to which coal is applied, with one notable exception, viz.: for smelting ores in blast furnaces, and it is our belief that at no distant day it will be used for this, but not in the present style of furnace.

Being so free from all deleterious elements, notably sulphur, it makes better iron, steel, and glass, than coal fuel. It makes steam more regularly, as there is no opening of doors and no blank spaces are left on the grate bar to let cold air in, and when properly arranged regulates the steam pressure. Boilers will last longer, and there will be fewer explosions from unequal expansion and contraction, due to cold draughts of air let in on hot plates.

Gas engines of large size can be built to be driven by natural gas, as in the case of the Otto and other styles.

For domestic purposes a beautiful fire can be made, dust, ashes, and coal carriage avoided; smoke, and the smoked ceilings and walls of Pittsburgh, may become things of the past; yet, if sold at about fifty cents per thousand cubic feet, it is much more costly than coal, especially if used in grates and stoves constructed for coal. The invention of burners for its more economical consumption in stoves must follow its general introduction. Most of its users consume it in such a crude manner that they fail to get its best results, the difficulty being the expense of making the necessary changes in the burning. There is, however, one exception where it is being used with economy, in Siemen's regenerative furnaces.

The committee determined experimentally the value of natural gas as a fuel in comparison with bituminous coal in generating steam. One pound of coal evaporated nine pounds of water, and one pound of gas (23.5 cubic feet) evaporated twenty pounds of water. In other words, 1,000 cubic feet of natural gas will evaporate 800 pounds of water, and to do the same with coal requires 90 pounds, or about 1¼ bushels.

So long as meters are not employed in measuring the volume of gas consumed in manufacturing establishments, it is scarcely probable that owners will study economy in its use. But with an increased demand for natural gas—particularly when its superior heating qualities and low price, as compared with coal, are understood—the officials of the supplying companies will doubtless take such action as will prevent the reckless waste of this valuable natural product. If, for instance, as it might be shown by cheap contrivances easily applied, a factory could be better supplied with only one third the present consumption of gas, the owners would certainly deem it no hardship if a meter was placed at their establishment, provided rates were not increased. In fact, it is most probable that a perfect system of supply will reach many more consumers, and with rates much lower than have heretofore been charged. At present the want of method by the companies forbids as rapid a development of the gas supply as the public wants really require. Heretofore it seems that contracts have been made to supply the gas at rates only a trifle less than the cost of coal; but in the haste to declare dividends the companies seem to forget that by permitting its reckless waste by a few large consumers, they are crippling a resource which would yield better financial results through a more general distribution at more reasonable rates.

Natural gas has about one half the illuminating power of coal gas. By means of fans, a mechanical mixture with the vapor of heavy hydrocarbons can be effected, whereby illuminating gas, at a cost of not more than 40 to 50 cents per thousand cubic feet, can be offered the public. These heavy hydrocarbons, the products of refining petroleum, have hitherto had but a low commercial value. Possibly the same elements may also be supplied from the smoke of the thousands of coke ovens in the vicinity.

It has also been attempted to apply natural gas to the conversion of iron into steel.

Experiments having in view the dephosphorization of iron through the agency of the hydrogen of natural gas have been made, but thus far the results have been very unsatisfactory. Imperfectly burned at a high temperature, the gas deposits carbon in a form having a remarkable density. Upon this principle the manufacture of electric light carbons is now carried on.

The tendency of the gas, under pressure, to absorb and carry off oil and grease, leads to its being used for the cleansing of delicate fabrics.

The powerful reducing action of the gas upon metallic oxides at high temperature may lead to its application to the smelting of metals on a large scale.

The application of gas to glass making, on account of the purity of the fuel, has led to the production of superior plate glass. More rapid fusion is possible, and covered pots are found unnecessary.

The varying requirements of a large iron works will render it desirable to be able at all times to control an unlimited volume of gas, supported by high pressure.

The importance of having the high pressure mains, as they enter the city, subjected to careful tests, and the mode of laying such pipes under municipal supervision, are evident. The fact that natural gas, if mixed with air, will explode on contact with fire, and is in effect the dreaded fire damp of the coal mines, is no argument against its introduction and general use under due precautions. The qualities which render it explosive when mixed with excess of air are the very ones which render it valuable as a producer of light and heat. The following trials were made with a view to ascertaining the limits of its inflammability. Different mixtures of measured quantities of natural gas and air were prepared, and, also, mixtures in the same proportions of coal gas and air. The effect was noted when a coal gas flame was plunged into each. From these results we concluded that in a room filled with air containing 1-10 to 1-12 natural gas, the danger would be one

of explosions; above or below these limits there would be danger of fire but not of explosion. On the other hand, if the air in a room contains 1-6 or 1-7 coal gas, contact with flame would cause explosion, while with an admixture of 1-10 or 1-11 of coal gas, there would be danger of fire, but not of explosion. As will be seen, as regards safety, there is a difference in favor of coal gas. Natural gas brings with it from the well, minute quantities of heavier liquid or solid hydrocarbons in the form of vapor or spray, by the force of the gas under pressure, which imparts to it a strong and characteristic smell.

A peculiar substance resembling butter is often taken from the mains bringing the Murraysville gas to the city. This substance was found to contain common salt, water, small quantities of lime and magnesia salts, coarse sand, and a considerable quantity of solid paraffin, all blown into light froth. The odor of the gas in the mains appears to be dependent upon traces of condensible hydrocarbons, for if kept in a closed vessel for a few days, the gas becomes absolutely odorless. The odor will diminish more and more as it is carried away from the wells, or from the high pressure mains. This may explain the contradictory statements upon this point which have found circulation.

It has been found that air containing 10 per cent of Murraysville gas (fresh from the high pressure mains) has a decided odor; this is also true of Freeport and Creighton gas, but the same gas, after standing in an air-tight glass for twenty-four hours, lost every trace of odor.

In conclusion, it may be of great importance to all interested, to call attention to the remarks made by Professor J. P. Lesley, the Chief of the State Geological Survey, in relation to the so called "belt theory." Often lines have been run in locating oil and gas wells, having a certain compass-bearing from another well, and the professor combats this notion in the following words:

"It is needless to remark, that this method of locating an oil or gas well from another, must necessarily prove ineffectual, because it imagines the plane of the oil to be in the vertical, whereas it spreads horizontally. Local surveyors and civil engineers, not being trained geologists, are naturally disposed to overvalue the powers of their special professional instruments, the compass or transit, and it is not to be wondered at if, in the confusion of men's ideas about oil, and the origin of natural gas, the engineer's compass should have made a stiff fight to keep the field over which it had, so to speak, the right of preëmption.

Since rock oil and gas in union with salt water are held by horizontal layers of loose sand and gravel, and since these layers of sand and gravel were of course deposited in and by running water, currents in an ancient and probably rather shallow sea, it is clearly useless to attempt to follow their irregular courses underground by surveying straight transit lines across the present surface of the country. The straighter the compass line is run—in other words the more skillful the engineer—the less will his line correspond to the real lines of direction of the ancient oil and gas bearing sand and gravel banks meandering and branching a thousand feet beneath him. He can no more tell, by means of his compass, through what narrow channels in the narrow and more or less crooked sand bar the oil is slowly moving, than a boy, by drawing lead pencil lines on the top of a pile of boards, can tell what is the direction of the grain, or the movement of a worm in the hundredth board down from the top.

Even on the impossible supposition that his lines may for once correspond to the grain of the hundredth board, they certainly could not correspond also to the grain or worm holes of the hundredth and tenth board, representing, say the second sandrock of the oil; and still less to the hundred and twentieth, representing the stray sand; the hundred and thirtieth, the third sand, etc.

The collective exhibit of Pennsylvania was made officially by the State, and was very grand and comprehensive. The mineral exhibit was made principally by the State, but partly by individuals and railroad companies.

In the State collection there were shown specimens from various coal fields or mines, and rocks and building stones.

Fine specimens of *anthracite coal* from the mines of the Philadelphia and Reading Coal Company were exhibited. They resembled jet. One specimen weighed 1,600 pounds.

Anthracite coal from the Girard estate. One block weighing 3,255 pounds, jetty black and lustrous, was also shown.

Coke from Connellsville; very fine.

Piles of *crude iron ore* and *pig iron*.

One case contained 16 specimens of iron and iron ores, pyrolusite, etc., with analysis of each on label, a very instructive and interesting exhibit by Carnegie Bros. & Co., Bessemer.

One case containing specimens of steel, beautifully shown, by Miller, Metcalf & Parkin, Pittsburgh.

C. G. Hussey & Co., Pittsburgh, showed copper and brass manufactured

goods. One circular disc was a quarter of an inch thick, and at least 10 feet in diameter. There were also planished and tinned ware, brass kettles, etc.

Piles of *copper ore* (chalcopyrite in calcite) from French Creek Mine, Chester.

Rocks and building stones in great variety. On one small column of dark veined marble, attention was called by the label to certain obscure figures, which had a vague resemblance to a human figure.

One case of minerals was shown by the Lebanon Valley College. It was a small collection, but the specimens were clean, and neatly labeled and displayed.

Two large double cases of Pennsylvania minerals were loaned to the State exhibit by A. E. Foote, of Philadelphia. They contained a general collection of the principal minerals of the State, all of which were good specimens—some magnificent—all labeled with name and locality. There were in all 250 specimens. The following is a list of the most interesting:

Alophane,
Amethyst,
Amphibole,
Andalusite,
Anglesite,
Anthophyllite,
Anthracite,
Ankerite,
Apatite,
Apophyllite,
Aragonite,
Autunite,
Azurite,
Barite,
Beryl,
Biotite,
Bornite,
Brucite,
Calamine,
Calcite,
Celestite,
Cerussite,
Chabazite,
Chalcopyrite,
Chrysocolla,
Copper, native,
Corundum,
Cuprite,
Cyanite,
Dendrites,
Deweylite,
Diaspore,
Doppelerite,
Enstatite,
Fluorite,
Fibrolite,
Galenite,
Garnet,
Göthite,
Graphite,
Greenockite,
Halotrichite,
Hematite,
Heulandite,
Hyalite,
Hydrocuprite,
Limonite,
Magnesite,
Marcasite,
Margarite,
Melaconite,
Melanterite,
Molybdenite,
Muscovite,
Oligoclase,
Orthoclase,
Penninite,
Pyrrhotite,
Pyrite,
Pyromorphite,
Pyroxene,
Quartz, green, blue (in many varieties),
Randanite,
Ripidolite,
Rutile,
Saponite,
Serpentine,
Siderite,
Sphalerite,
Staurolite,
Stilbite,
Sulphur,
Tourmaline,
Uranite,
Wollastonite,
Wulfenite,
Yellow Ochre.

A very interesting exhibit of slate from quarries in Bangor was made by Benedict & Davis. The display was made in a slate-covered kiosk. It consisted of roofing slates, billiard table tops, and a slate burial case or sarcophagus.

RHODE ISLAND.

One of the original thirteen States. Area, 1,306 square miles. Population in 1880, 276,531. Capitals, Providence and Newport. Show space in Exposition buildings, 3,565 square feet. The State is divided into 5 counties. The surface is generally rough and hilly, but there are no mountains.

There are but few minerals in the State of economic value that are worked. They consist of slate, anthracite coal of inferior quality, iron ore, limestone and marble, serpentine, granite, and other building stones.

Rhode Island is not in any sense a special or important mineral State.

The State minerals were displayed in two small glass table cases. The collection was small, but contained all the characteristic species in good and in some instances fine specimens.

SOUTH CAROLINA.

One of the original thirteen States. Area, 29,385 square miles. Population in 1880, 995,577. Capital, Columbia. Floor space in Exposition,

10,175 square feet. State divided into 32 counties. The coast is flat and sandy. For 100 miles inland there are low hills which increase in altitude to the summit of the Blue Ridge in the northwestern part of the State. The highest land (Table Mountain) is 4,000 feet above sea level.

South Carolina may properly be classed with the important mineral producing States of the Union. The principal minerals of economic value are gold, copper, lead, marbles and building stones, iron ores, chrome iron, corundum, ochre, steatite, and phosphatic minerals used very extensively as fertilizers and for the manufacture of phosphorus.

Gold

Has been somewhat largely produced in South Carolina. The general character of the deposits and manner of working do not differ materially from those described under the head of Georgia and North Carolina. There are several vein mines worked which resemble those of California.

1867	$1,200 54 in gold from this State was deposited in the United States Mints.
1875	No gold produced.
1880, yield	$40,000.
1881, yield	35,000.
1882, yield	22,500.
1883, yield	57,000.

Gold was more largely produced in this State before the discovery of that metal in California.

The total deposits of South Carolina gold in United States Mints from 1804 to June 30, 1883, was:

Gold	$1,468,854 10
Silver	457 76
	$1,469,311 86

Forty-two imitation gold bars, representing $1,000 each, were exhibited by the Haile Gold Mining Company, of Lancaster County, as the product of last year.

Specimens of gold quartz were shown from the West Gold Mine, Union County, which resembled the auriferous quartz of Fresno Flat, Fresno County, California. This mine was opened in 1882, and commenced milling with 20 stamps in 1883.

The gold belt crosses the northwest portion of the State. Large nuggets have been found and many mines worked.

MINES IN SOUTH CAROLINA.

Report of State Agricultural Society, 1884.

ANDERSON COUNTY.

Number of mines in the county (?) Mica, corundum, plumbago, and others. This county contributed among the largest of the collections of minerals of any county to the agricultural department.

Number of quarries (?) There are numbers of good quarries in the county, notably at Pendleton, Simpson's Mill, Dark Corner Township, Honea Path, Williamston, on Tugaloo and Seneca Rivers, and Wilson's Creek. The latter has been used for millstones.

CHESTERFIELD COUNTY.

Number of mines in the county, 3. Name and names of proprietors: Brewer Mine; Kirkley Mine, owned by C. L. Evans; Oro Mine, owned by J. J. Hicks. Location: Brewer and Oro, Jefferson; Kirkley, Mount Croghan.

Character: Brewer, free ore, surface washing; Kirkley, same character, not in operation; Oro, gold-bearing rock, no free ore, not in operation.

Capital employed: Brewer, $60,000; Oro, $1,500; total $61,500. Value of annual product,

Brewer, $10,000. Percentage of metal to ore, per ton, Oro ore now being assayed in New York. Class of machinery, first class. Number of hands, 10. Increase or decrease in business within the year, no statement. Percentage of net profit, not stated.

KERSHAW COUNTY.

Number of mines in the county: Only one gold mine, not worked.

Number of quarries, 2; not worked now. Character: Granite, equal to any in the world; unlimited supply.

LANCASTER COUNTY.

Number of mines in the county: About 10. Names, location, and proprietors: Haile Gold Mine, Flat Creek Township; Gay Gold Mine, Flat Creek Township; Blackman's Mine, Flat Creek Township; Jones Mine, Flat Creek Township; Shuter Mine, Beaufort Township; Hunter's Mine, Gills Creek Township; Stevens' Mine, Gills Creek Township; Indian Land Mine, Indian Land Township; Funderburk Mine, Beaufort Township; one not named.

Character: The Haile Gold Mine is a first class vein. The Gay Mine is of fine promise. These are the only two now operated. Capital employed in both mines, about $300,000. Product, from $3,000 to $7,000 per month. Class of machinery: The most improved for separating sulphur from the gold. Number of hands employed, 110 white. Increase or decrease in the business in the last twelve months: A considerable increase—about 30 per cent.

The Haile Gold Mine is operated by a wealthy New York company. The operation of the works goes on night and day for every day of the week, Sunday not excepted. The machinery used is of the most improved pattern. There are two roasting furnaces and twenty-stamp mills, propelled by powerful steam engines. In all there are about five steam engines. The great trouble hitherto has been the separation of the sulphur from the gold. This is now successfully effected by the use of the roasting furnaces and the highly improved machinery introduced by the northern proprietors.

In connection with this mine the company operate a large store and also a steam saw-mill. They have lately erected a church at or near the place. Around these mining and other works there has grown up a village of some moment. And indeed it may be well said that this company is doing a great deal for Lancaster County. The mine is improving in reputation, and is probably surpassed by few if any in the State. It is well known that gold can be found anywhere, more or less, in the eastern part of the county, and it is thought that this may prove to be a famous gold region, needing only development.

No quarries in the county in operation.

LAURENS COUNTY.

1. Number of mines in the county: none worked. Traces of gold abound in the county and some traces of silver have been found. There is an extensive field of corundum near the town of Laurens, on lands of Mrs. Susan W. Simpson, of E. P. Simpson, and others.

2. Quarries in the county: 1. Location, thirteen miles west of Laurens, near Brewerton Post Office. Character, limestone and marble of the best quality. Class of machinery, "drills, hammers, and wheelbarrows." Capital employed, $500. Value of annual product, $1,000. The best quality of soapstone abounds in several localities; also best quality of marble and limestone, and first class building and working granite. All these resources are neglected, but must some day invite attention and development.

OCONEE COUNTY.

There are no mines worked in the county, though minerals, especially gold, abound, and gold has been successfully mined.

PICKENS COUNTY.

1. Number of mines, etc.: None yet developed. The county has asbestus, mica, granite, and gold.

2. Number of quarries: only one partially developed. Character, granite of the best quality. Class of machinery, primitive. Capital employed, little or none—not over $150. Annual outturn, not over $500 worth of stone delivered.

UNION COUNTY.

1. Number of mines in the county: 5 gold mines. Two of these mines are operated, and three are not:

First—The West Mine, owned and operated by the West Mining Company; is composed of northern proprietors, and is located twelve miles northwest of Union C. H. It has been worked about two years by the present company. The veins are in talc and mica-slate formation. A 20-stamp mill is in operation day and night. From 50 to 75 hands—25 white and 50 colored—are employed, with a capital of about $20,000. The value of the ore is from $2 to $50 per ton.

Second—The Thompson or Fair Forest Mine; is located twelve miles northwest of Union C. H., and adjoins the West Mine. The formation is the same as the West Mine. A 10-stamp mill is now operated at the mine. The value of the mill is about $5,000. The value of the ore is from $5 to $100 to the ton. There are three well defined veins on the property that assay high. This is a very valuable mine. The number of hands at present employed is 20, colored.

Third—The Nott Mine; is located about ten miles northwest of Union C. H., and about three miles from Glenn Springs. This mine is slate formation, with quartz ore in large bodies, and reported to be a true fissure vein by M. Tuomey, State Geologist. This mine is not now operated, but it was before the war, by a company composed of South Carolinians. The value of the ore is from $5 to $100 per ton. It was very productive formerly, and yielded an immense profit. Ore was taken from the vein that yielded 3,000 pennyweights in eleven bushels of ore.

Fourth—The Norris & Nucholls Mine; is located sixteen miles northeast of Union C. H., on the Pacolet River. The mine is not in operation. It was worked previous to the war and paid well. The value of the ore is from $3 to $100 per ton.

Fifth—The Posey Mine; is located about eleven miles northwest of Union C. H., near the West Mine. It is of the same formation as the West Mine, and the ore is about the same value. This mine was operated before the war, and was considered very rich.

The general exhibit of South Carolina was large. The mineral section was altogether a remarkable exhibit. The most striking object was a pyramid of "*Phosphates*" from 25 to 30 feet high, built of medium fragments. At the base large masses were piled, also bags of manufactured fertilizers and glass jars of prepared fertilizers. On sunken panels the following statistics were painted:

Total value of fertilizers manufactured	$3,000,000
Annual shipment of phosphate rock	400,000 tons.
Annual shipment of fertilizers	155,000 tons.
Total value of phosphates mined, per annum	$2,500,000

A large block of South Carolina marl found beneath the phosphate beds, three or four feet thick, was shown in this section.

A SKETCH OF THE HISTORY, ORIGIN, AND DEVELOPMENT OF THE SOUTH CAROLINA PHOSPHATES.

Compiled by A. R. Guerard, A. R. S. M., Mineralogist for the New Orleans Exposition for the Department of Agriculture, Columbia, South Carolina.

THE HISTORY OF THE DISCOVERY.

South Carolina (sometimes known as Charleston) phosphate, was discovered in the latter part of 1867, at a place called "Lambs," about twelve miles above Charleston, on the Ashley River. The marls of Carolina appear to have been known and identified by geologists as far back as 1797. In 1832 attention was drawn by Mr. Ruffin, of Virginia, to the fact that these marls were valuable as a fertilizer; and in 1848 Tuomey, in his Geological Report of South Carolina, speaks of irregular and water-worn fragments of marl stones, found in the Ashley River marl-beds, and claims for these a value far above the Virginia marls, because they contained from 1 to 10 per cent of phosphate of lime. In 1850, Prof. Holmes, of Charleston, read a paper before the "American Association for the Advancement of Science," in which he described nodules of marl rock, referring to them as "silicious" masses. So called "rocks" or "stones," found lying on the surface of the land, or turned up in plowing, were well known to old planters on the coast. But it is evident that, though these rocks or nodules were long an object of scientific investigation and local curiosity, the true nature and chemical composition of the Carolina phosphates were as yet unknown and unsuspected. It was not until 1867 that the late Dr. St. Julien Ravenel, of Charleston, upon receiving some specimens of these nodules, recognized their value and pointed out their agricultural importance. The deposit *in situ* was discovered by Prof. F. S. Holmes, who, with Dr. Ravenel and Dr. Pratt, of Atlanta, shares the credit of a discovery which has proved and must continue to be a source of wealth to South Carolina, and a benefit to agriculture, both in this country and in Europe, the importance of which cannot be estimated. It may seem strange that the value of this deposit should not have been recognized before, when it was lying here, seen, but neglected, under the very eyes of geologists and chemists, some time after the agricultural use of phosphate of lime was known to the world. But South Carolina, before the war, being in a state of agricultural prosperity, there was, doubtless, less importance attached to this matter than would otherwise have been the case; and, as usual, it was the necessity of effort—the demand for a means of livelihood—which led to the great discovery. By that wonderful

provision of nature which so often awes and impresses us, the aid was given, the supply furnished, when the demand was greatest. The first company organized to excavate the phosphates was the Charleston Mining and Manufacturing Company, which was formed with northern capital, furnished by Messrs. George D. Lewis and Frederick Klett. The first shipment by this company was sixteen tierces, by steamer Falcon, consigned to George D. Lewis, Philadelphia, Pennsylvania. The manufacture of commercial fertilizers, under the chemical superintendence of Dr. St. J. Ravenel, had begun in Charleston shortly before this, using the Navassa phosphate as a source of phosphoric acid. Henceforth, native phosphate was substituted for the Navassa phosphate; and, under Dr. Ravenel's direction, new fertilizer works were put up to utilize the phosphate which was now being mined at home.

OCCURRENCE AND CHARACTER OF THE PHOSPHATE DEPOSIT.

The phosphate deposit occurs in beds or strata of rough masses or nodules, of a size varying from a part of an inch to several feet in diameter, and is associated with numerous fossil bones and teeth. It is found on the bottoms of the shallow creeks and rivers which intersect the coast, and on the low lands which form a belt of country running parallel to and from ten to fifty miles from the seaboard. The beds are from 6 to 20 odd inches in thickness, and the limit of a workable deposit is 8 feet underground or 20 feet under water. The phosphatic nodules are known as "land" or "river" rock, according to the element in which they are found. The average yield of the land deposit is 600 to 800 tons to the acre, and though sometimes occurring in "pockets," that is irregularly, these deposits are remarkably uniform, many contiguous acres often containing a phosphate-bearing stratum at an accessible depth. The "river" rock having been washed into the rivers from the land, has occasionally accumulated in thicker beds than the original deposit of land rock. The "river" rock is obtained by dredging, chiefly in the Bull, Stono, and Coosaw Rivers; the "land" rock is dug mainly in the section of country lying between the Ashley and Stono Rivers and Rantowle's Creek. Extensive strata of excellent quality are also known on the banks of the Edisto, and between the Edisto and Ashepoo Rivers, but this deposit has not yet been worked to any extent. About and below Beaufort occur a number of very heavy beds of "river" rock, but generally of lower grade. The "land" rock is lighter in color than that found under water or marsh mud, the former having a yellowish or pale brown color, the latter a dark gray or bluish black. The river rock is considerably harder than that occurring in the land deposit, but either variety may be readily ground to a powder so fine that it floats in air (so called "floats"). Carolina phosphate gives out when rubbed a peculiar fetid odor, the denser it is the more conspicuous the odor, due to the presence of organic matter. It is very porous, some of it being capable of absorbing 15 to 20 per cent of water. The surface of the nodules is frequently indented with holes and cavities naturally filled with clay and sand, which require to be carefully washed out; when the washing is imperfectly performed the phosphate is of lower quality. Carolina phosphate is remarkably uniform in composition, containing on an average from 55 to 61 per cent of tricalcic phosphate, and from 5 to 11 per cent of carbonate of lime. Among its other constituents are silica, oxide of iron, fluorine, sulphuric acid, traces of alumina and magnesia, water, and organic matter.

ORIGIN OF THE PHOSPHATIC DEPOSIT.

The question of the origin of the phosphate of lime in this deposit has as yet received too little study to afford a satisfactory theory. But it awakens such general as well as scientific interest in the minds of all who have seen or heard of the deposit, that it may not be amiss to state briefly the several hypotheses which have been advanced. One of these assumes that the fragments of marl were charged with the sweepings from guano beds formed above them by the congregation there, at some past period, of vast flocks of birds; in this case the bones of the birds should be among the fossils preserved in the deposit, but no such remains have been found. Another theory supposes that as the remains of numerous extinct animals, such as the mastodon, elephant, megatherium, tapir, horse, deer, etc., occur associated with the beds, immense herds of these animals must have collected at one time about shallow salt licks or lagoons, formed during a partial submergence of the coast, in which the nodules of marl were left upon the recession of the sea, and that the phosphoric acid derived from their bones and excrements brought about the change in the marl. It is objected to this theory that the places where the most bones, etc., are found, are not the richest in phosphate, and while it is by no means probable that the nodules were in all, or even in most instances formed where they are at present found, it is difficult to suppose that agencies of such local and restricted character as salt licks could account for the conversion of so great a mass of material, over an area so extensive as that presented by the phosphate formation, and that a similar deposit found at a depth of seventy feet in the artesian well borings at Charleston could not be explained in this way.

The most plausible theory advanced as an explanation of the formation of these nodules is that certain marine organisms or mollusks possess the power of secreting phosphoric acid from sea water, and that through them the marl, and especially the upper strata, became charged with a certain amount of phosphate of lime. That the proportion of the phosphate of lime thus obtained to the whole body of the superficial layers of the marl was afterwards increased; first, by the removal of a considerable amount of carbonate of

lime, rendered soluble by the percolation through it of rain water containing carbonic acid, derived from the decomposition of vegetable matter in the soil overlaying the marl; second, by a well known proneness of phosphoric acid, when diffusely distributed, to concentrate and to give rise to concretionary processes similar to those observed in the flint nodules and pebbles of the English chalk, and in other formations. This theory agrees with the diffused occurrence of phosphate of lime in the superficial layers of the marl, as well as with the fact that the upper layers of the deposits and the outside of the nodules are the richest in phosphate. It substitutes for a local cause a general one, commensurate at once with the wide area occupied by the phosphate rock, and by the phosphatic marls of the South Atlantic seaboard. Such a cause, also, might have been in operation ages ago, when the layers of phosphate rock found in the artesian well borings were forming; and it may be in operation now, as the dredging work of the United States Coast Survey shows that the marls accumulating at the depth of 200 fathoms on the floor of the Gulf Stream, between Florida and Cuba, contain a considerable percentage of phosphate of lime. (See Handbook of State of South Carolina, and Emmons' report to Pacific Guano Company, 1876.)

THE WORKING OF THE LAND DEPOSIT.

Having carefully examined the land for phosphate, its depth, thickness of stratum, etc., a field is selected and drained by means of trenches, technically known as "line pits," dug around the tract and reaching below the level of the rock bed. This field is about 600 yards wide, and made as long as possible for transportation of the rock dug. A tramroad for horse, or steam, is constructed through the midst of the field in its length, and then, commencing at the "line pits" and working in towards the tram, pits measuring 6 by 12 feet, are sunk in long parallel lines. The superincumbent earth is thrown up with shovels behind the men, and the phosphate rock dug out with picks and cast on the untouched ground in front. When trees are in the field they are undermined and thrown over on the side which has already been excavated. The rock is rolled from the pits in barrows and dumped on platforms on the roadside, whence it is loaded into cars for transportation to the washers. The labor on the phosphate fields is performed almost altogether by negroes, sometimes convict labor being employed. Italians have occasionally been imported as laborers, but they have not been found to do the work required as well as the blacks, who alone can stand the hot suns and malaria of the phosphate swamps in Summer. The hands are not generally paid by the day, but by the foot dug, the price being in most mines 25 cents a foot for a pit of 6 by 12 feet, the rolling of the rock inclusive. At this wages they make about $1 a day on the average—sometimes more and sometimes less—according to the character of the land and depth of rock from the surface. Land miners have not considered it profitable to work deposits at a greater depth than eight feet beneath the surface.

The clay, sand, etc., adhering to the rock, which amounts to one half or two thirds of the whole mass, is removed by washing. The crude rock as it comes from the pit is carried to the washers, large, heavy pieces of machinery, worked by steam, and situated near some creek or river where there is an ample supply of water. The rock is here passed first through roller crushers, armed with steel teeth, which break up the larger nodules to a uniform size of not more than four inches in diameter. These then fall into long wooden troughs or tubs resting on a slight incline, through which revolve wooden shafts furnished with iron teeth fixed in the form of a spiral screw. The nodules being forced up the incline against a strong stream of water are rubbed one on the other until cleansed of all clay, etc., and are thrown out at the open end of the tub. After being screened they are then transported to the dry sheds, or dumped outside the washer building. The land deposits are owned by companies or individuals, or are leased upon a royalty for a term of years.

THE WORKING OF THE RIVER DEPOSIT.

The river deposit is now worked principally by dredging, but some years before the shallower creeks were exhausted of rock large quantities of phosphate were raised by "hand picking," "tongsing," and "diving." "Hand picking" was resorted to in such deposits as run dry at low water, and consisted in loosening the nodules by means of the pick and crowbar and throwing them into flatboats to be carried to the shore. "Tongsing" was the term applied to raising such deposits as were too deep to be hand picked, but which were within reach of the oyster tongs. Diving was occasionally practiced by the negroes in Summer, in water six to ten feet deep, to bring up large loose nodules which were too heavy to lift with the tongs. These apparently primitive methods of working answered admirably as long as the deposits were shallow and labor cheap, but it was not long before the more powerful appliances of steam and machinery came into use.

A very large portion of the Carolina phosphate, and by far the largest portion of the river deposits, are now raised by dredging from deep waters, where the nodules lie on the bottom, sometimes covered by a layer of sand and mud several feet in thickness. The dredges heretofore employed have been found to work best in not more than twelve feet of water, twenty feet being the limit. At this depth they are able to tear up the thickest and hardest phosphate beds; and under favorable circumstances as much as 100 tons of rock a day have been raised to the dredge. The dredge, which is the ordinary single machine, empties the mass of nodules, marl, sand, mud, shells, etc., on a floating washer of simpler though similar construction to that employed for washing land rock. The clean rock is loaded into "lighters" or barges, and transported to dry-sheds on shore.

Several efforts have recently been made with specially adapted machines to raise the deposit lying at greater depths and in larger quantity than the ordinary dredge can do, but so far none of these attempts have been successful. At the present time there are two immense dredging machines in progress of construction which are calculated to do more and better work than has yet been done, but these machines are not at work, and no opinion, therefore, can be formed of them. There is no doubt, however, that the more inaccessible deposits will be excavated whenever the demand for phosphate is sufficient to necessitate the supply, and though that day may not yet have arrived, it is not so far distant.

One of the most important operations in the preparation of phosphate rock for market is the drying of it, though it is one which has been much neglected by phosphate miners. The river rock has long been dried for foreign shipment in order to lessen the cost of freight, and to raise the percentage of phosphate of lime in the rock. But land rock, which has been chiefly consumed at home, is seldom dried even now to less than six or seven per cent of water, and contains often as much as ten per cent, the local fertilizer works purchasing the rock wet and drying it as needed.

The most satisfactory method of drying employed so far is the hot-air process, sun drying being too slow and uncertain to be efficacious, and other methods tried having proved too expensive on the large scale. A hot blast of air is forced by a fan through perforated iron pipes into a brick kiln or dry-shed; into these sheds, which hold 500 tons and over, the wet rock is dumped upon the pipes, over which are sometimes laid logs of wood to aid in distributing the heat through the mass. In this way 500 tons can be dried in thirty-six hours to from one to three per cent of moisture. This process would seem to entail a great waste of heat and fuel, but it answers sufficiently well in practice, and as long as wood is cheap is more economical than any other.

The river miners work under charters from the State, which grant them a general right to work a specified territory with any other comers, or under an exclusive right to such territory. In either case they pay a royalty to the State of one dollar for every ton of rock raised.

NUMBER AND NAMES OF COMPANIES MINING PHOSPHATE ROCKS.

The following list gives the names of companies at present engaged in mining land and river rock:

Land Mining Companies.

(1) Charleston Mining and Manufacturing Company. Works on Ashley River, near Charleston.
(2) Gregg's Phosphate Mines. Works on Ashley River, near Charleston.
(3) Pinckney's Phosphate Mines. Works on Ashley River, near Charleston.
(4) Rose Phosphate Mining and Manufacturing Company. Works on Ashley River, near Charleston.
(5) Pacific Guano Company. Works on Bull River.
(6) St. Andrews' Phosphate Mining Company. Works on Stono River.
(7) Wando Phosphate Mines. Works on Ashley River, near Charleston.
(8) Bradley's Phosphate Mines. Works on Rantowle's Creek, near Charleston.
(9) Drayton & Co.'s Phosphate Mines. Works on Ashley River, near Charleston.
(10) Bolton Phosphate Mines. Works on Stono River, near Charleston.
(11) Chisholm Phosphate Mines. Works on Ashley River, near Charleston.
(12) Fishburne Phosphate Mines. Works on Ashley River, near Charleston.
(13) Pon-pon Phosphate Mines. Works on Edisto River.
(14) Dotterer's Phosphate Mines, Works on Church Creek, near Charleston.

River Mining Companies.

(1) Coosaw Mining Company. Works on Coosaw River, near Beaufort.
(2) Oak Point Mines Company. Works on Wimbee Creek, near Beaufort.
(3) Sea Island Chemical Company. Works on Beaufort River.
(4) Farmers' Phosphate Company. Works on Coosaw River.
(5) Hume Bros. & Co. Works on Beaufort River.

In addition to these the following individuals are mining on a smaller scale on individual rights:

(6) David Roberts. On Wimbee Creek.
(7) J. W. Seabrook. On Morgan River.
(8) J. M. Crofut. On Beaufort River.
(9) J. DeB. & J. Seabrook. On Parrot Creek.
(10) Willis Wilkinson. On Stono River.
(11) J. G. Taylor. On Parrot Creek.

The Land Mining Companies engaged employ a capital of \$1,980,000; 1,286 hands, with \$363,560 wages. Their products amount to \$1,283,830.

The River Mining Companies engaged employ a capital of \$525,000; 649 hands, with \$259,300 wages. Their products amount to \$907,170.

The total capital employed is \$2,505,000; number of hands, 1,935; wages, \$622,860; products, \$2,190,000.

(See Handbook of State.)

Mined and Shipped.

The following table gives the total amount of phosphate rock mined and shipped since the discovery of the South Carolina deposits:

1868–70	20,000 tons.	1879	200,000 tons.
1871	50,000 tons.	1880	190,000 tons.
1872	60,000 tons.	1881	265,000 tons.
1873	90,000 tons.	1882	335,000 tons.
1874	100,000 tons.	1883	355,000 tons.
1875	115,000 tons.	1884	409,000 tons.
1876	135,000 tons.		
1877	165,000 tons.	Total	2,699,000 tons.
1878	210,000 tons.		

Of this amount:

River rock	1,229,170 tons.
Land rock	1,469,830 tons.
Total	2,699,000 tons.

This amount at the very moderate average of $6 per ton has given to the State $16,149,000, of which the State has been benefited by a royalty of $1,229,170.

The cost of production per ton varies. It is estimated at $4 50, including the payment of royalty and other expenses. Upwards of 100,000 tons of crude rock are annually consumed by the fertilizer manufactories of South Carolina.

The value of the phosphate now annually mined is $2,500,000. The royalty paid to the State in 1884 was $153,797 62, being one dollar per ton paid as moved by the marine companies. The taxes levied on the product of the land companies, and the heavy tax on the fertilizer manufacturers, are exclusive of this large amount of revenue.

See Annual Report of *News and Courier*, and View of the (Industrial Life of the State).

No systematic survey determining the extent of these deposits has yet been attempted. The only information on this head comes from prospectors seeking easily accessible rock in localities convenient for shipment. Widely varying estimates as to the quantity of the rock have been ventured. Some have placed it as high as five hundred millions of tons and others as low as five millions. The latter is the estimate of Dr. C. U. Shepard, Jr., who has prepared a map of the region. He traced the deposit over 240,000 acres and estimates the ACCESSIBLE rock as covering only about 10,000 acres. Even this estimated area, at 800 tons per acre, which he gives as an average, should yield 8,000,000 tons. But if we examine a single mining region, as that for instance occupied by the Coosaw Company, we must conclude that he has very greatly underestimated the amount. This company has the exclusive right to a territory of about 6,000 acres in Coosaw River, besides the adjacent marshes yet unexplored. Everywhere the river bottom is covered with rock, which for the most part forms a solid sheet, varying from eight inches to one and one half feet in thickness. Taking the lesser thickness, we have, with a specific gravity of 2.5, after subtracting twenty-five per cent for loss in washing and drying, something more than 1,700 tons to the acre, which would give for the river territory alone belonging to this one company something more than ten millions of tons. And, in effect, this company (which is the only thoroughly equipped river mining company now at work, 1881) consider, in spite of their large plant, that their supply of material is practically unlimited.—[*Handbook of the State.*

COMPETITION FROM OTHER QUARTERS.

But it may be asked is our little State the sole possessor of these phosphate beds, or have we to fear competition from other quarters? The deposits of phosphate rock have been found at various points along the South Atlantic coast, reaching from North Carolina to Florida, and also in Alabama. But these deposits have not yet been sufficiently developed to compete with the South Carolina phosphate, and will probably not come into the market until our deposits are nearly exhausted. There are numerous phosphate deposits in Europe, among which may be mentioned the Spanish phosphorite, the Canadian apatite, the Bordeaux and Nassau phosphates, the English and French coprolites, the Belgian phosphates, the Navassa phosphate, and the guanos of the islands of the Pacific Ocean; but none of these phosphates, though some are much richer than ours, can at present compete with us in accessibility, cheapness, and uniform quality. Occasionally there are rumors of vast deposits being discovered in Russia, in the Pacific islands, etc.; but so far the South Carolina phosphate forms the backbone, so to speak, of the phosphate industry not only of America, but of England. And it should be remembered, moreover, that even should we meet with competition abroad and thus lose the foreign trade in phosphate, which is now very large, our home trade is ever on the increase, and that it is to the Western and Southwestern States of the Union that we should look for our future field of consumption. In this field, at any rate, we need hardly fear competition as long as these deposits can supply the demand.

THE MANUFACTURE OF COMMERCIAL FERTILIZERS.

The gigantic manufacture of artificial manures is based on the treatment of phosphate of lime with sulphuric acid, by which the phosphate of calcium is decomposed, sulphate

of calcium formed, and the phosphoric acid converted into a soluble acid calcium salt (a superphosphate), or else reduced to the free state. The suggestion to act on bones with sulphuric acid was made by Liebig (1840); the utilization of crystalline and fossil phosphates by a similar treatment was the work of Lawes (1843).

The process of manufacturing superphosphate of lime ordinarily employed, which is the one carried out at the fertilizer works near Charleston, is briefly as follows: The kiln dried phosphate rock is ground to powder in mills such as are used for grinding flour, and then treated with sulphuric acid in the proportion of 900 pounds of chamber acid of 49 degrees Beaumé to 1,000 pounds of phosphate. This is performed by machinery in so called "mixing tubs" or "manure mixers," the product being a superphosphate containing ten to twelve per cent soluble phosphoric acid. From the mixer the manure, which is still liquid, is run into storehouses where it is allowed to set. It becomes so hard after a time that it has to be cut down with a pick, and the lumps passed through a disintegrator to reduce them to powder, which is then filled into bags and is ready for shipment. Certain gases are given off during the mixing; these are carbonic acid, fluoride of silicon, hydrochloric acid, and water. Most of these are extremely irritating to the lungs, and injurious to health and vegetation, their perfect removal is a vital necessity, and flues for this purpose are placed above the mixer.

In making most phosphate manures a mixture of ingredients is employed. Either it is desired to produce a manure containing a certain definite percentage of soluble phosphate, or to introduce nitrogen and potash into the manure. To attain the first object, a higher and lower quality of phosphate are mixed together before treating it with acid; for the second object the acid superphosphate is mixed afterwards with ammoniacal matter—dried blood, fish scrap, etc., and German potash salts (kainit, or muriate of potash). The manures resulting from such mixtures are known as "acid phosphate," "dissolved bone," "ammoniated acid phosphate," "complete fertilizer," "ash element," etc.

All the more important fertilizer works near Charleston manufacture their own sulphuric acid; this indeed constitutes one of their most expensive operations. For this purpose sulphur is imported from Sicily, only one of the works near Beaufort using iron pyrites from Spain. Superphosphate of lime supplies to the soil large quantities of phosphoric acid, sulphuric acid, and lime; and in the case of a mixed manure, also nitrogen and potash. In analysis of superphosphates, the phosphoric acid is estimated in three forms, as soluble in water, soluble in citrate of ammonia, and insoluble. The soluble phosphate (by which is meant phosphate soluble in water), consists of monocalcium phosphate with some free phosphoric acid. When applied to the land the soluble phosphate is dissolved by rain, and distributed more or less throughout the surrounding soil. When thus brought in contact with fertile soil, the soluble phosphate is more or less speedily precipitated. This precipitation is brought about either by the carbonate of lime in the soil, or by the hydrated oxide of iron and alumina present. In the first case a more or less insoluble phosphate of lime, and in the second a basic phosphate of iron and alumina are formed. As basic phosphates of iron and alumina are certainly forms of phosphoric acid which can only be slowly appropriated by plants, it is evident that the main effect of soluble phosphate must be yielded within a short time of its application. The insoluble phosphate of the superphosphate was formerly supposed to consist simply of the original phosphate of the material which had escaped the action of the acid; we now know that the insoluble phosphates consist partly and in some superphosphates largely of "reduced" or "reverted" phosphates, that is phosphates which have GONE BACK to the insoluble condition owing to the action of the lime, iron, and alumina. There has lately been much discussion in the agricultural and chemical world as to the manurial value of these reduced and insoluble phosphates as compared with the phosphates soluble in water. It has been argued by some that the manurial value of reduced phosphate must be equal to that of soluble phosphate, because soluble phosphate itself becomes reduced after contact with the soil; and hence they have consented to call at least a part of these reduced phosphates "available" in the soil. Others have gone farther, and maintain that the non-crystalline insoluble phosphate, such as the Carolina phosphates, when ground to an impalpable powder, and composted with vegetable matter producing carbonic acid upon decomposition, or used along with certain liguminous plants as a fallow crop, are equally efficacious as reduced or even superphosphate. They hold that the use of sulphuric acid in the manufacture of superphosphate is not only unnecessary and expensive, but absolutely injurious. The late Dr. St. J. Ravenel, of Charleston, was of this opinion, in which he is confirmed by the views of several distinguished chemists in England, Scotland, France, and Germany, and by practical results in the field, both at home and abroad.

NUMBER OF COMPANIES ENGAGED IN MANUFACTURING FERTILIZERS IN SOUTH CAROLINA.

There are at present engaged in manufacturing commercial fertilizers in South Carolina:

(1) The Atlantic Phosphate Company—capital, $200,000; works located on Ashley River, near Charleston.

(2) The Stono Phosphate Company—capital, $135,000; works located on Ashley River, near Charleston.

(3) The Etiwan Phosphate Company—capital, $300,000; works located on Cooper River, near Charleston.

(4) The Pacific Guano Company—capital, $1,000,000; works located on Ashley River, near Charleston.

(5) The Wando Phosphate Company—capital, $100,000; works located on Ashley River, near Charleston.

(6) The Ashepoo Phosphate Company—capital $50,000; works located on Ashley River, near Charleston.

(7) The Edisto Phosphate Company—capital, $200,000; works located on Cooper River, near Charleston.

(8) The Ashley Phosphate Company—capital, $100,000; works located on Central Wharf, Charleston.

(9) The Wilcox & Gibbs Guano Company; works located on Cooper River, Charleston.

(10) The Hume Bros. Phosphate Company—capital, $500,000; works located on Beaufort River, near Charleston.

(11) The Port Royal Fertilizing Company—capital, $125,000; works located on Battery Creek, near Port Royal.

MANUFACTURED FERTILIZERS SHIPPED.

The following table gives the total amount of fertilizers shipped since 1871:

Shipped From.	1871—Tons.	1872—Tons.	1873—Tons.	1874—Tons.	1875—Tons.	1876—Tons.	1877—Tons.
Charleston	20,487	37,183	56,298	46,302	49,500	47,381	45,766
Savannah	27,447	32,922	56,296	30,895	33,187	33,000	45,591
Port Royal					4,000	12,000	26,000
Totals	47,934	70,105	112,594	77,197	86,687	92,381	117,357

Shipped From.	1878—Tons.	1879—Tons.	1880—Tons.	1881—Tons.	1882—Tons.	1883—Tons.	1884—Tons.
Charleston	52,000	55,000	80,000	100,000	95,000	130,000	143,790
Savannah	61,500	60,000	65,000	110,000	100,000	125,000	70,000
Port Royal	15,000	12,000	26,000	39,245	28,279	25,000	23,094
Totals	128,500	127,000	171,000	249,245	223,279	280,000	236,884

Note.—Of the shipments from Port Royal, 11,022 tons were fertilizers manufactured at the works in Beaufort. (See Annual Report of *News and Courier*.)

CONSUMPTION OF FERTILIZERS.

In a compilation by Mr. De Ghequier, Secretary of the Chemical and Fertilizer Exchange of Baltimore, we find:

Total consumption of commercial fertilizers in Southern States	460,000 tons.
Delaware, Eastern States	25,000 tons.
Pennsylvania, New York, New Jersey	90,000 tons.
New England States	40,000 tons.
Western States	20,000 tons.
Total	635,000 tons.

According to this statement it would appear that the South Carolina companies are able to produce at least one third of the whole amount of fertilizers consumed in the United States.

CONCLUSION.

In this sketch, which has necessarily been brief and imperfect, attention has been drawn only to the most remarkable facts in the history, origin, and development of the South Carolina phosphates. Statistics up to date have been given, showing that the phosphate industry has steadily increased in importance every year since the discovery of the deposits, until to-day it constitutes the largest and most successful enterprise in the State. The benefit that has been conferred, not only on the planters of the State and the southern country in general, but also upon the whole agricultural world, by the development of these phosphates, cannot now be computed. For ourselves, it is impossible to realize what we would have done without them, and we dread to think of the day when they will have become exhausted. I venture to say, however, that this last we need not fear; at least for years, even generations to come. And by the time that South Carolina has exhausted her supply, let us hope that the deposits in some of our sister States will have been sufficiently developed, not only to furnish us with phosphates as bountifully as we have done them, but have enough to spare for the rest of the world.

One of the most attractive displays in this department was that of fossils found in the phosphate beds. There were two private collections shown, one by E. Willis and the other by C. A. Scanlan, both of Charleston.

Mr. Willis' collection was displayed in six large table cases. It consisted of large sharks' teeth, vertebræ of mammals and fishes, shells, teeth of elephants, ear bones of whales, and human remains; a great profusion and a very fine collection. I have reason to hope that we shall be able to procure some of these specimens, by exchange, for our State Museum.

Iron ores, rocks, and building stones, street pavement blocks, marbles, and ores were shown in quantity, and a few interesting mineral species, among which I noticed the following: *amethyst*, fine; *asbestus; barite; chromic iron; corundum; dolomite; kaolin and clays; meteoric iron; mica*, fairly good; *ochre; steatite; tourmaline*, green and black.

TENNESSEE.

State, June 1, 1796. Area, 45,600 square miles. Population in 1880, 1,542,359. Capital, Nashville. Floor space in Government Building, 11,812 square feet. The State is divided into 94 counties. The eastern borders of the State are crossed by spurs of the Appalachian Mountains, the highest peaks of which rise 5,000 feet above the sea. From these to the Cumberland Mountains there is a succession of valleys and hilly country, having an average elevation of 1,000 feet. The Cumberland plateau has an area of 5,100 square miles. The Western Tennessee plateau is a great undulating plain, sloping toward the western border and the Mississippi bottoms. The rivers of the State furnish ample water power. Being to a great extent mountainous, it is natural to infer that the State would produce minerals abundantly. This was shown to be the case by the grand mineral exhibit made at the Exposition.

The State is abundantly supplied with coal and iron. The Alleghany coal field extends into Tennessee, with an area of 5,100 square miles. The coal contained in it has been estimated at 42,127,360,000 tons. The Soddy coal mines are in Hamilton County, on the Cincinnati Southern Railroad, twenty-one miles from Chattanooga. In 1882, 2,500,000 bushels were shipped from these mines; 300 men were employed, earning each from $1 to $3 per day. The average selling price was 6½ cents per bushel. The Etna mines are in Marion County, fourteen miles from Chattanooga. The coal is extensively used in the iron furnaces in and about Chattanooga. Coke is largely manufactured. The gross product of coal in Tennessee from 1873 to 1882, inclusive, was 5,126,042 tons.

Iron ores are very abundant. The mineral is hematite, limonite, specular iron, and siderite. Limonite and red fossil ores only, are generally utilized in the manufacture of iron. The ores of iron are practically inexhaustible. In Lawrence County alone they are estimated at 100,000,000 tons. There are now and have been large numbers of iron furnaces in active operation. The product of pig iron in 1882 was 137,602 tons.

I visited the Citico furnace, at Chattanooga, in May, 1885. This is a new and well appointed modern iron furnace which was working well and producing large quantities of iron of excellent quality. It does not materially differ from those at Birmingham, Alabama, or even from the furnace at Clipper Gap in California, except that it is on a much larger scale than the latter.

The ore costs at the furnace $1 50 to $1 75 per load; lime, twenty-five cents per ton; coke, $4 50 per ton. Two and one half tons of ore make one ton of pig iron.

I learned here that it is not necessary to "blowout" a furnace when it is desirable to discontinue the production of iron for a time. A furnace may be "banked," when it will remain in a state of inactivity for thirty or forty

days without injury. The operation is as follows: The blast is slackened and fuel added from time to time, but no ore or limestone flux. This is continued until all the slag and metal is run out. The heat in the stoves is lessened until the blast is cold. The tuyeres are then withdrawn and the holes plugged and cemented air-tight. Fuel is added from above and covered with a layer of dried earth. The furnace can be started again by simply commencing the blast.

Gold was first discovered in Tennessee on Coca Creek, Monroe County, in 1831. The usual gold excitement followed. The yield was never great. Two dollars per day won by panning was above the average, and the mines were soon abandoned. The total deposits of Tennessee gold and silver in United States Mints to June 30, 1883, was:

Gold	$87,175 12
Silver	7 28
	$87,182 40

The greatest yield was in 1848, when $7,161 worth was taken out.

Copper was discovered in Tennessee in 1843. In 1847 Mr. Webber, a German, obtained a lease of the ground and commenced shipping ores to Boston. In 1850 Mr. John Caldwell came to Ducktown and commenced mining. Refining works were put up in 1860, and a copper rolling and wire works was erected at Cleveland soon after. The product of copper ingots by the Union Consolidated Company from 1865 to 1873, inclusive, was 8,476,872 pounds.

The Burra Burra Company produced, in 1872, 917,329 pounds of ingot copper.

Zinc and lead ores have been somewhat worked in the State.

Marbles and building stones are found in great abundance. The celebrated Tennessee marble was first found in Hawkins County. Attention was first called to it by a block being sent to the Capitol at Washington. Now the quarries furnish on an average 10,000 cubic feet annually. It is now found in six other counties. In 1881, 80,000 cubic feet were shipped from the quarries of the State.

Roofing slates, clays, glass sand, and ochre are among the economic minerals produced in Tennessee. Petroleum is found over a large area, but only a few thousand barrels have been produced.

The collective exhibit made by Tennessee was very fine and extensive. An appropriation was made and the exhibition was official. The economic ores and minerals were shown in abundance, and the exhibit was more conspicuous from the quantity shown than from the number of varieties. The ores and the coal were piled on platforms and tables. It was an important and most interesting display. The most important minerals shown were *coal and coke; phosphatic minerals; calamine; cerussite*, good, a single small specimen; *galena*, fine, but small specimen; *graphite*, rather poor quality; *hematite; kaolin; limonite; magnetite*, very fine; *ochre; pyrolusite*, good; *smithsonite*, fine; *copper ores*, with ingots of metallic copper; *pig iron and manufactured iron; iron ores*, weighing many tons; *silver ores*, inferior quality; *zinc ores and metallic zinc*.

The exhibit of marbles was exceptionally fine. Slabs, vases, ornaments, from the well known mottled Tennessee marble to a light gray homogenous variety slightly clouded. One vertical case was shown containing 48 one-foot slabs, very fine. The whole marble exhibit was on a grand scale. There was shown, also, a black marble burial casket or sarcophagus. Other building stones were shown—granites, porphyries, serpentines, very fine.

TEXAS.

State, December 29, 1845. Area, 327,504 square miles, the largest State in the Union. Population in 1880, 1,591,749. Capital, Austin. Floor space at the Exposition, 18,145 square feet. The State is divided into 174 counties. The surface is generally low or table land. The principal ranges are the Guadalupe, Sierra Hueca, Eagle, Sierra Blanca, and the Apache Mountains. Some peaks reach an altitude of 6,000 feet.

The principal economic minerals of the State are *coal, copper, gold, iron, kaolin, lead, salt*, and *silver*, but none of the mines have been extensively worked. It may be said that the mineral fields of this State are not yet prospected or known.

The collective exhibit made by Texas was large and well arranged. All the products of the State were represented. The State Legislature appropriated $20,000.

The mineral exhibit was quite extensive, and contained many elements of interest. The collection was made by private individuals.

I was informed that the Constitution of Texas specially provides that no money shall be expended for geological surveys. The minerals were partly gathered and arranged by Dr. A. Gregg, of San Saba. At the Exposition they were in the care of Dr. William De Ryee, of Corpus Christi. The specimens that I found the most interesting, were the following: A suite of carboniferous coals from several localities in the State.

One slab, covered with fossils, very fine. A very creditable and interesting exhibit of fossils from various formations. Dr. De Ryee showed me fossil leaves in steatite which, if he is not mistaken in the character of the matrix, is very remarkable.

Of minerals there were shown:

Agate; asphaltum, resembling the best Trinidad, breaking with conchoidal fracture. This mineral is found on the seashore, near Corpus Christi. It washes ashore during storms. Schooner loads are gathered and sold on the ground for $35 per ton: *blende* crystals, fine; *chrysocolla; cuprite; gypsum*, fine; *hematite* (pipe ore) fine; *kaolin; limonite; magnetite; onyx marble*, El Paso; *pyrite; selenite*, fine; *siderite; ores of copper, iron, lead*, and *silver; pig iron; blocks of building stone*—limestones, red granite, freestones, bricks, red, nearly white, and curiously mottled, the latter from Rusk, Cherokee County; fire-bricks, and bricks sawed from a white material resembling volcanic ash.

A beautiful mantelpiece of fossiliferous limestone was on exhibition at the headquarters. The panels were painted by ladies of Austin. The Texas Pacific Railroad made a large exhibition of Texas minerals in their collective exhibit of State resources. Specimens of coal from the Gordon Mine, Eastland; building *stones, marbles, bricks, grindstones, pottery ware, adobes*, etc., were shown.

VERMONT.

State, March 4, 1791. Area, 10,212 square miles. Population in 1880, 332,286. Capital, Montpelier. Floor space in Government Building, 5,062 square feet. The State is divided into 14 counties. Vermont is named from the principal mountain chain within its borders, the Green Mountains. It was the first State admitted into the Union under the Federal Constitution. The surface is diversified by mountain and valley, elevated plateaus, lakes, and rivers. The mountains rise to a considerable height and extend over a large area, for which reason it would be supposed that

Vermont would be a highly productive mineral State. This, however, it is only to a limited degree. *Building stones*, *marbles*, *slates*, etc., are found in the greatest profusion, but metallic ores are rare. *Iron ores*, *manganese*, *copper pyrites*, *clays*, *steatite*, and even gold, have been found, but the deposits have never been mined to any considerable extent.

The mineral exhibit made by the State of Vermont was very fine. The most showy if not the most important feature was the display of marbles, in which the State is specially rich. The beautiful building in which the headquarters were located was grandly wainscoted with Vermont marbles. There were eight large slabs used for this purpose, each a special and beautiful variety. But these and pavements of tesselated marbles, tiles, and ornamental borders were simple when compared with the imposing Arch of Titus, in Vermont marble and granite, which was erected in front of the headquarters building. This magnificent structure was 18 feet high, 16 feet wide, and 6 feet in thickness through the arch. There were 500 cubic feet of marble and 150 cubic feet of granite used in its construction, and its weight was about 120,000 pounds. The following more detailed description was placed on the arch:

This arch is modeled after the celebrated "Arch of Titus" at Rome, with such modifications as were necessary on account of the materials used and the method of construction.

The bases on either hand, are of Vermont granite, showing all the best varieties produced in the State, at Barre, South Ryegate, St. Johnsbury, and Brattleboro.

The polished columns are of Vermont marble, and include four kinds, viz.: extra dark blue Rutland, Sutherland Falls, East Dorset Italian, and Mountain dark.

The large panels are of blue Rutland and Mountain dark marble; the keystone of blue and white Rutland, polished. The balance of the stock used shows the different grades of Rutland marble—sawed, sand-rubbed, or with coped edges. The tile immediately within the archway is of East Dorset Italian and Isle La Motte.

The entire structure above the granite was contributed by the Producers' Marble Company of Rutland, Vermont, and exhibits the different varieties they are quarrying.

This company is an association of five firms and corporations, and is the largest organization of the kind in America, if not in the world; its members representing a capital invested of over $6,000,000, with a mill capacity of 280 gangs of saws, and 15 rubbing beds, requiring to operate its machinery over 3,500 horse power (steam and water), and an average force of 3,000 men.

The Producers' Marble Company have a large private exhibit of monuments, etc., in the main building, adjoining the dairy exhibit, Section G G, Nos. 59 and 60.

Besides the arch and pavements, were shown a column of Barre granite, highly polished, and blocks and samples of granite from the rough to the most finished examples of the stonecutter's art. This special exhibit was made by Wetmore & Morse of Barre.

There was also shown a small column of serpentine, labeled "*verde antique*." The display of slates was very fine. A set of stationary washtubs, of steatite, was shown, and a great variety of ornamental slabs, vases, large monuments of granite and marbles, photographs of quarries, etc. There were also four cases of minerals and rocks, illustrative of the geology of the State, but I was not enabled to obtain a catalogue of them. Altogether, the mineral exhibit of Vermont was very fine, and to the credit of the State. It is not generally known that gold has been produced in this State; but I find it recorded in the reports of the Directors of the United States Mint that up to June 30, 1883, gold and silver from Vermont had been deposited in that institution, as follows:

Gold	$10,981 27
Silver	43 50
Total	11,024 77

VIRGINIA.

One of the original thirteen States. Area, 45,000 square miles. Population in 1880, 1,512,565. Capital, Richmond. Floor space at Exposition, 10,175 square feet. The State is divided into 99 counties. Virginia is a mineral State, in the broadest sense. There are so many mountains and broken lands that the minerals are brought to view or are within easy access to the prospector, which is not the case in level States.

The mineral resources of Virginia are not fully developed, yet many valuable minerals are known to exist within the State. *Gold*, *silver*, *iron*, *copper*, *lead*, *zinc*, *tin ores*, *coal*, *building stones*, *limestones* and *marbles*, *brick* and *fire clays*, *glass sand*, *graphite*, *manganese*, *gypsum*, *salt*, *pyrites*, *marls* and *fertilizers*, etc., are mined to a greater or less extent. Gold is found in a belt from 15 to 25 miles wide, extending 100 miles or more. There has been considerable mining activity in Fauquier, Culpepper, Spotsylvania, Orange, Fluviana, and Buckingham Counties.

Virginia gold has been deposited in United States Mint to June 30, 1883, as follows:

Gold	$1,707,733 67
Silver	165 01
	$1,707,898 68

Recently, since the value of gold has increased—owing to a reduced production—a renewed activity in gold mining has been developed in Virginia. The following extract from a letter to the *Mining Review* gives important information on this subject:

> Mining lands are cheap in this State and labor is cheap; top hands $1 per day and good miners at from $1 to $1 50 per day. Wood only costs 40 cents a cord and lumber for buildings is delivered on the mine for $10 per thousand feet for all kinds. The climate is first class; no chills or fevers of any kind. The citizens are all good law-abiding people, and we have good schools and churches and a good healthy country. Provisions are plentiful and cheap. Railroads are plentiful, running very near the mines, the C. O. R. R. one side and the Virginia Midland R. R. on the other, with the P. F. P. R. R. on the other and the R. F. P. R. R. the other side. Thus we have everything here for successful mining, including the very necessary article, the metal itself; our ores are running from $5 to $25 per ton. We have plenty of ores, the veins averaging four feet all through the leads.

The mineral exhibit made by Virginia at the Exposition was very fine and comprehensive; 83 counties were represented. All the minerals were classified in the following State subdivisions:

1. Tidewater Virginia.
2. Midland Virginia.
3. Blue Ridge and Piedmont Virginia.
4. Great Valley of Virginia.
5. Appalachian Virginia.

Most of the specimens were collected and arranged by Major Jed. Hotchkiss, Editor of the *Virginias*, of Staunton, and Assistant U. S. Commissioner, aided by an appropriation of only $800. The very full catalogue was first printed in the *Virginias*, and cut out and pasted in a blank book. This was afterward reproduced in the Handbook of Virginia, by Randolph Harrison, the Commissioner of Agriculture, Richmond, 1885, in which much other valuable information may be found.

The catalogue shows the collection to be very extensive; too much so to be described in detail here. The catalogue consisted of sixty-four pages of closely printed matter. There were also many geographical, geological,

and special charts and maps shown. The minerals were placed on terraced tables, and were well displayed. The specimens were all clean and distinctly labeled, and while the selection was not made for beauty, but rather to convey a correct idea of the minerals as they occur in nature, there were many fine and even magnificent specimens of great interest to the scientific mineralogist as well as the technologist. It is to be hoped that the magnificent collection will be placed in some central city in the State, and become the nucleus of a grand State museum.

The minerals were exhibited partly by the Virginia Department of Agriculture, and were partly loaned by individuals or corporations.

Ores and minerals of a like character were often shown in several counties, the object of the collection being to represent the general mineral resources of the State, rather than to make a scientific classification. The most important minerals I observed are embodied in the following list:

Coal and coke; fertilizers—the fertilizers found in the State seem to be tertiary shell marls and greensand: extensive beds of these minerals are stored up by nature for future use; at Evergreen the deposit seems to be 20 feet thick; *asbestus; barite; chalcopyrite; corundum; erubescite; graphite; kaolin; mica; ochre*, good quality; *pyrolusite; argentiferous galena; copper ores; ferro-manganese; gold-bearing quartz; iron ores and pig iron*, in large piles; *manganese ores; concentrated pyrites; tin ore*, Martha D. Cash Mine, Rockbridge County; *zinc ores and bars of metal;* fine model of the natural bridge, a very attractive feature of the Exposition; *bricks; building stones*, a large collection; *china clay; fire clay; glass sand; granite; grindstones and grindstone grits;* hydraulic limestones; limestones; *marbles*, in blocks and slabs; *millstones; mineral waters; slates; whetstones*, etc.

WEST VIRGINIA.

Separated from Virginia, December 31, 1862. Organized a State, June 19, 1863. Area, 23,000 square miles. Population in 1880, 618,457. Capital, Wheeling. Floor space in Government Building, 3,200 square feet. The State is divided into 54 counties. The surface of West Virginia is generally mountainous and resembles Virginia. Minerals are found in abundance, but like those of Virginia their full extent and value still remain unknown. The State did not make a large exhibit at the Exposition. The mineral display was comparatively meager. The collection consisted principally of *blocks of coal, coke, iron ores, limonite* and *hematite*, *cannel coal*, very fine, *bricks*, *sewer pipe*, and other similar ware, *terra cotta*, etc.

WISCONSIN.

Territory, July 3, 1830. State, May 29, 1848. Area, 53,924 square miles. Population in 1880, 1,315,497. Capital, Madison. Floor space in Government Building, 6,750 square feet. Wisconsin is a vast plain or plateau, with an elevation of from 600 to 1,500 feet above sea level. The surface is generally undulating. The highest land rises only 1,800 feet. Although there are no great mountain chains in this State there is no scarcity of certain valuable minerals, such as *building stones*, *iron*, *zinc*, and *lead ores*, *clays*, *mineral waters*, etc. The total production of lead from 1862 to 1873 was 163,422,672 pounds. While gold is said to occur in Wisconsin, it has never been found in paying quantities.

The mineral exhibit at the Exposition was very small and insignificant. There was no appropriation made by the State, and the general exhibit was by individuals. While the mineral exhibit was so meager, it is only

fair to say that the general or collective exhibit of State resources was very fine and ample, which will no doubt be fully described in a State report. The importance of the Wisconsin exhibit may be realized when it is stated that 143 premiums were awarded, in value equal to $5,233, and including 3 gold medals and 15 silver medals.

The following are the most important of the few minerals shown: *blende*, fine crystals; *galena*, fine crystals; *limonite*, very fine, from the Chief Iron Mine, Ashead County; white or *cream colored brick*, very fine; *limestones; lime; iron ores*, Commonwealth Mine; *mineral waters*, etc.

ALASKA TERRITORY.

Has an area of 394,000 square miles. Population in 1880, 33,426. Alaska was not represented in the Exposition, but some of its mineral resources were shown in the government exhibit. The mineral resources of the Territory are not to any great extent known, but sufficiently so to warrant the hope and expectation that Alaska will develop into an important mineral Territory or State.

ARIZONA TERRITORY.

Territory, February 24, 1863. Area, 113,619 square miles. Population in 1880, 40,440. Capital, Prescott. Floor space in Government Building, 3,300 square feet. This Territory is one of the most important mineral regions of the United States. The surface is generally elevated plateaus, and mountains. The principal minerals now worked are *gold*, *silver*, and *copper*, but other valuable economic minerals abound. They will eventually be extracted when conditions change and they are wanted. The vast mineral resources of this Territory are still but comparatively little known, and they will not be fully realized by the present generation.

Gold is found sometimes free, but is generally associated with silver. Silver mines are largely worked. Arizona silver and gold were deposited in United States Mints to June 30, 1883, as follows:

Silver	$13,454,177 32
Gold	3,424,972 71
	$16,879,150 03

The following figures compiled from various sources, although no doubt but roughly approximated, will give a good idea of the importance of Arizona as a producer of the precious metals:

1869, yield of precious metals	$1,000,000 00
1870	800,000 00
1871	800,000 00
1872	625,000 00
1873	500,000 00
1874	487,000 00
1875	750,000 00
1876	1,500,000 00
1879–80	1,401,518 00
1881	8,360,000 00
1882	8,565,000 00
1883	8,183,743 00
	$32,972,261 00

The exhibit of Arizona minerals and ores in the Exposition was large and imposing, consisting as it did of large specimens in very large quantities from all the principal districts and mines of the Territory. There

was, besides, a large collection of views of mining machinery, mining scenes, etc. There were actually tons of ores from sometimes a single mine, conveying the idea of quantity as well as quality. Among the most noticeable exhibits were bars of bullion from the Benson Smelting Works.

The finest specimens were displayed in 22 elegant flat table cases.

Those from the Silver King Mine, which were rich and beautiful, were shown in two special elegant plate glass cases on stands. These specimens were mainly native silver in threads or wires, and in some cases crystallized, and the silver minerals cerargyrite, stephanite, proustite, argentite, etc., with galena and zinc blende, in calcite and quartz. There were many other well known silver mines represented in the table cases.

The Copper Queen made a special exhibit of magnificent ores from the mine, both in cases and on tables. One pyramidal specimen weighed 7,300 pounds.

The Longfellow Copper Mine was also represented by an elegant suite of copper ores in a large special vertical case. In the collection were magnificent specimens of *azurite*, in fine crystals.

Native copper; chalcopyrite, very fine; *calcite*, in fine, large, nearly transparent crystals, on a base of malachite and azurite—a very interesting association. In the same case were displayed ores and copper minerals from the Detroit Copper Mine, at or near the same locality.

A large vertical special case contained the private collection of Charles R. Wores, of Tucson. The specimens numbered 2,500; all were labeled, or rather furnished with numbers which referred to a written catalogue. The collection consisted principally of Arizona ores and minerals, well selected and displayed.

Copper ores, from the United Verde Mine, near Prescott, showed a remarkable association of cuprite, chrysocolla, free gold, and free silver. The ores resembled those found in the Inyo Mountains of California.

The Copper Bottom Mine was represented by ores—one large ingot, and the cooled contents of a slag kettle.

Bullion bars, from Howell Mine, and lead bars (lead bullion), from Tombstone, were also shown.

A special case contained ores and minerals from the Clifton Copper Mines, Pima County, fine bornite and other copper minerals already mentioned. The following information regarding this mine is quoted from the San Francisco *Mining and Scientific Press* of recent date:

THE COPPER MINES AT CLIFTON.

A VERY NARROW GAUGE RAILROAD.

From an extended article in the Deming (N. M.) *Tribune*, describing the mines of the Arizona Copper Mining Company, we make the following extracts: The property now includes the following claims: Coronado Lode, Crown Reef, Copper Crown, Matilda, Horse Shoe, Boulder, Copper Queen, Copper King, Thomson, Worfold, Goodsight, Vicksburg, Sherman, Humboldt, Joy, Yavapai, Detroit, Michigan, Ballyrat, Bartlett, Basset, Clifton, Longfellow, Modoc, Emma, Nora, Arthur, Princess Alice, Cornell, William Grant, Bendigo, Copper Pride, Fairview, Lolo, Cap Bonanza, Lucky Friday, Libbie Annie, Libbie Grant, Oriental, White Hawk, Black Hawk, Southern Cross, Fraction or Dark Horse, C. L. Junction, Peak, Northern Cross, Pyramid, Troy, U. Extension of Clay Mine, Dora, Seven Thirty, Regular, King, Ida, Arizona, Indiana, Richmond, Santa Fe, and Iroquois.

There has been steady progress in the means of transportation for the ores from these mines. At first the ore was taken to the little smelter, on the creek, on the backs of burros; then a wagon road was constructed, after the furnaces had been erected at the river, and large amounts were hauled down in wagons; then, about six years ago, at the suggestion of Captain Davis, a twenty-inch narrow-gauge road was laid up the cañon, first to the Longfellow Mine, and afterward extended to the others. The grade is generally about four per cent, or two hundred feet to the mile, but in several places it is as much as five, and in one or two places six per cent. The first engine was a little four-ton fellow, which is now in use on the upper road from the Longfellow around to the Detroit

Company's mines. This was substituted by one weighing eight tons, and a third one of twelve tons was afterward put on. It is really surprising to see the loads which these powerful little machines take up the steep grades, and to note the ease with which they are handled. They stop and start at any point and gain headway rapidly, although the average speed is but eight miles per hour. The cars are wholly of iron, and carry a load of three or four tons. Although the track is so narrow, the cars seem to ride just as steadily as on a broad gauge road. Not an accident has ever occurred to kill or wound a person since the road has been in operation, and this is no doubt largely due to the care exercised by Mr. Arbuckle, the engineer, who has been running the trains ever since the road was built. Although there is but comparatively little load up the grade, except for the Morenci Works, the engines are competent to take up eight or ten loaded cars, or fifteen to twenty empty.

THE INCLINES.

The ore from the several mines is moved down to the main track of the road we have described by means of inclines of varying degrees of pitch, the loaded car going down as the empty car goes up. The incline at the Longfellow is 2,200 feet long, 600 feet through a tunnel, and the elevation gained is 780 feet; at the Metcalf the incline is 1,100 feet long with 500 feet elevation; at the Coronado the incline is 3,320 feet, and the elevation 1,100 feet with a maximum grade of 68 per cent; at the Queen the length is 900 feet. At the Longfellow the four-ton cars are used the same as on the main line, two coming down together, and one loaded and one empty going up. The speed is regulated by powerful brakes at the head of the incline, the cables passing several times around large drums to which the brakes are fitted.

THE SMELTERS.

The plant now consists of three Fraser and Chalmers furnaces, each of 60 tons, and two Pacific Iron Works smelters of 40 tons capacity. As previously stated the water power of the river is utilized, and three turbine wheels are employed of different capacities, according to the work upon them. The principal one drives the Baker blowers, five in number, three number sevens and two smaller ones; another drives the crushers, and still another the pumps. To insure against a scarcity of water or injury to the wheels there is a fine Corliss engine with ample boiler capacity to be used as a substitute in cases of necessity. Benches have been cut in the hillside, which is nearly perpendicular in rear of the works, for the ore bins and chutes, so that the ore, fluxes, and fuels are unloaded from the cars by dumping directly into the bins at the proper level, and these are transferred to their appropriate places by tramways from the chutes to the bins emptying upon the charging floor.

The water is taken from the river about one mile above the works, and is brought through a flume eight feet wide by four feet in depth.

Close by the smelting works a substantial building accommodates the machine shops and repair shops of the company, not yet fully in operation. Recently the entire charge of the machinery has been placed with Mr. W. C. Boylan, who for two years past has been master mechanic of the Arizona and New Mexico Railroad. He is a very competent machinist and has tried his hand successfully at invention. One of his inventions is a steam attachment to clear the locomotive ash box while the train is in motion; another is an equalizer attached to car brakes to prevent the wheels from sliding.

Only two furnaces were in operation at the time of our visit, although three have been in blast most of the time. The production for the preceding week had averaged 13 tons of 98 per cent copper per day.

The total production of the mines was given me as nearly as possible by Mr. Russell, as follows: Under the former ownership between 45,000 and 50,000 tons of ore had been taken out, yielding 7,500 tons, or 15,000,000 pounds of black copper. The production by the present company, to May first, has been 9,000,000 pounds. The present rate of production is between six and seven million pounds annually, which is not quite half the capacity of the works, if they were in full blast. At the present low price of copper, although it is possible to manufacture the copper at a profit, it is not a sufficient inducement to work up the higher grades of ore, and as we have before noted, the object is to make the mine pay its way and to develop the ore bodies so that the production may be increased when the price shall justify it.

The following rare or interesting minerals were noticed and examined: *alabaster*, beautifully translucent; *cerargyrite*, fine, Julius Mine, Globe District; *cerussite*, very fine long needle crystals, Flux Mine, Pinal County; *chalcopyrite*, large specimen, United Verde Mine; *chrysocolla*, coated with drusy quartz; copper, native, Kay Mine; cuprite, very fine; imbolite; fire clay; *free gold* in quartz, Huachuca Mountains, and from other localities: *malachite* (mammillary), quite equal in beauty to the Russian or Australian specimens, from the Copper Queen Mine; *malachite*, in needle crystals, Old Globe Mine; *melaconite* (powdery form), United Verde Mine;

mineral waters; platinum, Hassayampa River; *pyrolusite*, in concretionary shells, Tombstone; *selenite; silicified wood*, blue, red, and yellow variegated, from the petrified forest in Apache County. Large specimens of this beautiful mineral were shown in piles several tons in weight. The Chalcedony Manufacturing Company had machinery in the main building where the petrified wood was cut into beautiful ornamental objects. Some of the natural specimens were very beautiful, and showed fine crystals of quartz and amethyst on a many-colored ground; wire silver, very fine; sphalerite, amber colored and transparent, very fine, Silver King Mine; *vanadinite*, Yuma County; *wulfenite*.

There is a large collection of Arizona ores and minerals in the California State Museum. Nearly all the specimens enumerated above are represented, and many others.

DAKOTA TERRITORY.

Territory, March 2, 1861. Area, 147,490 square miles. Population in 1880, 135,177. Capital, Bismarck. Floor space in Exposition, 10,175 square feet. The general surface of the Territory is undulating, and is a plateau, covered in part by prairie lands. In the southwest are the Bad Lands and the Black Hills, the highest peaks of which are 6,700 feet above sea level. The mineral developments in this territory are yet in their infancy. It is likely that it will become a very productive mineral region. Gold, silver, iron, tin, lead, coal, copper, mica, gypsum, asbestus, salt, and petroleum have been found. Building materials are good and abundant.

The only known gold fields of importance lie in the Black Hills. The gold belt extends through Butte, Lawrence, Pennington, Custer, and part of Fall River Counties. Gold and silver have been and continue to be largely produced. The Territory is credited with deposits in the Mints of the United States to June 30, 1883, as follows:

Gold	$17,283,843 89
Silver	159,844 86
	$17,443,688 75

The general exhibit of Dakota was very extensive and comprehensive. The mineral section was also well supplied with the mineral products of the Territory. The specimens were generally large and fine. In some cases ores from certain mines or districts were shown in large piles. The most important ores, rocks, and minerals are embraced in the following list: *coal* and lignite; *copper ores and bullion; gold ores* from Black Hills; *iron ores*, with columbite in a curious micaceous rock, in which the mica is in flat crystalline plates; concentrated tin ore (cassiterite) and bars of metallic tin; *asbestus; asphaltum* liquid, or *maltha*, resembling that so abundant in California; *cassiterite; galena; gold*, rich specimens; *gypsum*, good; *mica*, some fairly good; *salt; uranite*.

Building stones, magnificent slabs, cubes, and cylinders, exhibited by the Drake Polishing Works, Sioux Falls.

Bricks and brick clay, some red and others white, like the celebrated Milwaukee bricks.

IDAHO TERRITORY.

Territory, March 3, 1863. Area, 90,932 square miles. Population in 1880, 32,610. Capital, Boise City. Floor space in Exposition, 2,160 square feet. The surface of the Territory is generally mountainous, and it is one of the most productive and important mineral localities in the Union, although not yet wholly developed or even prospected.

Gold was first discovered in 1852, by a French Canadian, on the Pend Oreille River. Two years later, 1854, General Lander found gold while exploring for a military road. The historical discovery, however, which led to the rapid settling of the Territory and a large production of the precious metals, occurred in 1858 or 1859. The most noted and productive mining localities are Oro Fino, Florence, Boise Basin, Owyhee, Rocky Bar, Salmon River, Yankee Fork, Wood River, Cœur d'Alene, and Snake River. Gold and silver have been largely produced. The deposits in United States Mints to June 30, 1883, were:

Gold	$25,895,674 07
Silver	1,091,942 76
	$26,987,616 83

The following is taken from a handbook of Idaho, by James L. Onderdonk:

Alturas, Custer, Lemhi, and Shoshone Counties are at present the scenes of most active mining operations. Owyhee and Idaho Counties have been most productive in former years, and still continue to send forth their regular output of precious metals. Each of the last named has plenty of ledges that have never yet been developed. Washington and Kootenai Counties are rapidly coming to the front as ore producers. The remaining counties being chiefly agricultural, their mining interests have as yet attracted comparatively little attention.

The following table shows the estimated production of the precious metals in Idaho since first discovery:

Year.	Amount Produced.	Year.	Amount Produced.
1862	$5,000,000 00	1874	$3,100,447 69
1863	7,448,400 91	1875	1,983,720 27
1864	9,019,704 30	1876	2,267,013 36
1865	12,914,364 25	1877	3,474,787 69
1866	10,001,850 44	1878	2,657,216 91
1867	7,388,064 31	1879	2,553,634 58
1868	3,030,213 56	1880	1,634,637 19
1869	1,613,453 68	1881	4,915,100 00
1870	2,239,190 61	1882	5,500,000 00
1871	2,219,937 94	1883	5,000,000 00
1872	2,675,192 00	1884 (estimated)	6,500,000 00
1873	3,653,605 15		
		Total production	$106,790,434 84

At the Exposition 192 mines were represented. These included gold, silver, lead, copper, pyrites, and gravel mines.

The collective exhibit was very large and important. The Territorial Government made no provisions aside from the appointing of a Commissioner.

The exhibit was made through the exertions of the Commissioner and private individuals. The minerals were shown in eight special vertical cases, as follows:

No. 1. Wood River ores.
No. 2. Ores and minerals from Alturas, Boise, and Ada Counties.
No. 3. Skylark, Excelsior, Montana, and Silver Wing Mines. Dividends said to be $3,500,000.
No. 4. Copper ores. Washington, Custer, and Lemhi Counties.
No. 5. Ramshorn and Postboy Mines. Output, $2,725,000.
No. 6. Lemhi County Mines. Silver, lead, copper, and iron ores, coal, etc.
Nos. 7 and 8. Contained miscellaneous minerals, ores, including moss agates, lava rock, building stones, mica, very good and largely worked, argentiferous galena, gold ores, silver ores, lead bullion, etc.

Besides the minerals there was shown a fine collection of large photographic views of scenery, mines, metallurgical works, etc.

MONTANA TERRITORY.

Territory, May 26, 1864. Area, 143,776 square miles. Population in 1880, 39,150. Capital, Virginia City. Floor space in Exposition, 4,274 square feet. The surface of Montana is diversified by broad table lands or plains, and mountains. The main chain of the Rocky Mountains crosses the Territory, some peaks of which rise to an altitude of over 12,000 feet. The Territory is rich in minerals; next to California, it has produced more gold than any other State or Territory in the Union. Silver is also found in considerable quantity, with prospect of still greater production.

Gold was discovered in 1852, on Gold Creek, but no extensive mining was done until 1861. The first quartz mill was erected in 1863. Gold mining has been extensively conducted, but of late years the product has generally diminished, which has been the case in all parts of the United States, and generally the world over. The following is the estimated product of the precious metals, gold and silver, in Montana:

1862	$500,000 00	1874	4,000,000 00
1863	8,000,000 00	1875	3,573,600 00
1864	13,000,000 00	1876	4,210,989 00
1865	14,500,000 00	1877	3,963,514 00
1866	16,500,000 00	1878	3,930,146 00
1867	12,000,000 00	1879	4,725,000 00
1868	15,000,000 00	1880	4,900,000 00
1869	9,000,000 00	1881	4,960,000 00
1870	9,100,000 00	1882	6,920,000 00
1871	8,050,000 00	1883	7,800,000 00
1872	6,073,339 00		
1873	5,178,047 00		$165,884,635 00

This estimate, like all others of the precious metals in the United States, is only approximative. No reliable statistics are kept, as in other countries, and such statistics must be always regarded as the opinions of those best capable of estimating. Still, they serve to give an idea of the importance of the gold-producing area of the United States. In Montana the silver yield in later years has greatly exceeded the gold. In 1872 the silver yield was $351,944; and in 1873, $176,500, while in 1883 it was $6,000,000.

Up to June 30, 1883, precious metals from Montana were deposited in the United States Mints as follows:

Gold	$52,952,396 34
Silver	8,037,916 19
	$60,990,312 53

Other valuable metals and minerals abound in Montana, but, as in California, the extraction of gold and silver have generally engaged public attention.

At the Exposition, this Territory made but a small mineral display. The principal minerals shown were ores of *gold*, *silver*, *copper*, *lead*, *iron*, *lead bullion*, etc., arranged on two pyramidal tables, over which was a sign, stating that all were from dividend-paying mines. Elsewhere were shown *coal*, *copper bars*, and *copper matte*, and sundry ores. There was a special case in which a large quantity of rich gold specimens were displayed. Some of the nuggets were very large. Some rich specimens were also shown from

the Atlantic Cable Mine, Cable District, Deer Lodge County. One fine specimen from the Bell Mine showed native silver on erubescite.

NEW MEXICO TERRITORY.

Territory, December 13, 1850. Area, 121,200 square miles. Population in 1880, 119,565. Capital, Santa Fe. Floor space in Exposition, 6,900 square feet. The following extracts are from *Illustrated New Mexico*, by W. G. Ritch, 1883, circulated at the Exposition:

FACE OF THE COUNTRY.

The surface is marked with mesas, valleys, and mountains, foothills, bluffs, cañons, and mountain parks. The mountain ranges, from north to south generally, break into spurs, buttes, and foothills, diminishing in altitude, and graduating into mesas or high table lands.

In the northern part of the Territory the Culebra Range looms up to the east into the Raton Spur, and to the south is known, according to proximity to local towns, as Taos, Mora, and Santa Fe Mountains; to the west is the Conejos and Tierra Amarilla Ranges. Southeast of the old City of Santa Fe and east of the Rio Grande, a broken range runs south, variously known as the Placer Mountains, the Sandia, Manzana, Oscura, Jumanes, Fra Cristobal, Caballo, San Andres, and Organs, the latter crossing the southern border of the Territory near El Paso. To the east of the above range is a series of high table lands reaching to the mesa, known as the Llano Estacado or Staked Plains, and broken by the low mountains and peaks named on the maps as the Gallinas, Jacarillas, Carrizo, Capitan, Sierra Blanca, Guadalupe, Jarilla, Hueco, and Sacramento.

On the west side of the Rio Grande, from the isolated peak near the northern boundary, known as the San Antonio Mountain, another broken range runs south, as follows, and known locally as Petaca, Valles, Jemes San Mateo, Ladrones, Oso, Magdalenas, Socorros, Gallinas, Southern San Mateo, Pinos Altos, Burro, Black and Mimbres Ranges, and the Florida Mountains, near the southern border.

Farther to the west, and near the Arizona line, appears the continental divide, composed of mountains and peaks variously known as Tunicha, Chusca, Zuñi, Datil, San Francisco, Escudilla, Tulerosa, Luera, Mogollon, Pyramid, Stein's, Animas, and Peloncillo.

These mountains, equably distributed as they are, furnish a large water supply, a great amount of timber, and are excellent shelter for stock during storms.

ALTITUDE.

The mesas and table lands in the northern part of the Territory are generally about 6,000 to 6,500 feet above sea level. In the central portion of the Territory the mesas attain an elevation of about 5,000 feet, and in the south about 4,000 feet. The fall of the Rio Grande from the northern border of the Territory to the point where it cuts the New Mexico, Texas, and Chihuahua boundary is about 3,500 feet. The ranges generally rise from 2,000 to 5,000 feet above the mesas and high table lands. Mount Baldy, 18 miles from Santa Fe, is 12,202 feet high. Mount Taylor, in the Sierra San Mateo, is 11,200 feet high. Raton Pass, 7,893 feet; Costillo, 7,774 feet; Tierra Amarilla, 7,455 feet; Taos, 6,950 feet; Cimarron, 6,489 feet; Las Vegas, 6,452 feet; Glorieta, 7,587 feet; Santa Fe, 7,044 feet; Bernalillo, 5,104 feet; Albuquerque, 4,918 feet; Fort Wingate, 7,037 feet; Socorro, 4,655 feet; Silver City, 5,946 feet: Fort Stanton, 5,800 feet; Las Cruces, 3,844 feet; El Paso, Texas, 3,662 feet; Tucson, Arizona, 2,542 feet. Some of the mining camps are at an elevation of from 7,200 to 8,500 feet.

At Kansas City, 849 miles east of Santa Fe, the altitude is 763 feet; Denver, 338 miles north of Santa Fe, 5,240.

WATER-COURSES AND EXTENT.

The Rio Grande is the main river of the Territory. It rises in southwestern Colorado, at an elevation of 11,920 feet; it runs southerly and centrally through the Territory, mainly through a broad valley. Its tributaries are, from the west: The San Andres, the Chama, Jemez, Puerco of the East, Alamosa, Chuchillo Negro, Animas, and Polomas; from the east: Costilla, San Cristobal, Hondo, Taos, Picuris, Santa Cruz, Namba, Santa Fe, Galisteo, Tuerto, and Alamilla.

The eastern portion of the Territory is drained by the Canadian River (Rio Colorado), emptying into the Arkansas River; its tributaries are: Cimarron, Mora, Sapello, Concha, Pajarito, Ute, Revuelta, and Trujillo.

The Pecos River rises in the Santa Fe Range and drains the eastern and southeastern part of the Territory, emptying into the Rio Grande. Its principal tributaries are: Vaca, Tecolote, Bernal, Gallinas, Salado, Yeso, Spring, Hondo, Feliz, Atrasco, Pañasco, Seven Rivers, and Black.

The northwestern part of the Territory is drained by the Rio San Juan, with tributaries as follows: Pinos, Navajo, Animas, La Plata, and Mancos. The Puerco of the West, the Zuñi, and Tulerosa Rivers are in the central west.

The Rio Miembres, Rio Gila, and San Francisco are in the extreme southwest of the Territory.

Numerous small streams, arroyas, and springs are to be found all over the Territory.

MINERALS AND PRECIOUS STONES.

The mineral wealth of New Mexico has been known to exist for centuries. Indeed, the traditions and knowledge existing among the village Indians of Mexico at the date of the conquest by Cortez was of a great people and of great mineral wealth in Aztlan (the white or bright land), as the country far to the north, since named New Mexico, was known early in the sixteenth century. It was less than a decade later than the landing of Cortez that the shipwrecked Cabeza de Baca and party started from the gulf coast, somewhere between the Cities of New Orleans and Galveston, upon the forlorn hope of reaching the settlements of their countrymen in Mexico. During the weary wanderings of this stout hearted and persevering party, they penetrated to the heart of the continent at a point nearly twenty degrees of latitude north of the City of Mexico, and nearly the same distance north of the last settlement of the Spanish colonists. The journey was beset with all the perils and uncertainties of a trackless wilderness inhabited by savage tribes, upon a tortuous route of thousands of miles, occupying five years in traversing. Nothing but the most subtle tact, indomitable will, dauntless courage, and endurance of steel, could have possibly surmounted the difficulties. And not then, we are bound to believe, had the wanderers found less humanity and hospitality than was found as related among a people living in houses, tilling the soil, and possessing provident care and methods of government not to be despised among the more pretentious civilized nations. And thus it was that the first Europeans set foot upon the soil of New Mexico, and gathered information which, when reported to the Viceroy of Mexico, confirmed the wonderful stories and traditions that had previously been related of that "*white and bright land*," and set on foot the expeditions of Niza, Coronado, Ruiz, and Espejo, and gave to the world the first knowledge of the mineral wealth of the country, and that historical significance of which New Mexico and Santa Fe is the seat and center.

Espejo, who is regarded as the more reliable of the early explorers, frequently makes reference to the presence of precious metals. Thus upon or near the lower Rio Grande he speaks of "many mines of silver, which, according to the judgment of skillful men, were very plentiful and rich in metal," and in another paragraph of "abundance of rich metals." At Paola (Bernalillo County), of finding in their towns and houses, "many sorts of metals, whereof some seemed to be very good." At Zia, he says: "They shewed them rich metals, and the mountains also not farre off where they digged them." Of a mine he visited near Zuñi, Espejo says he "tooke out of the same with his own hands exceeding rich metals holding great quantitie of silver." Returning from Zuñi he "found twelve leagues east of Quires (Santo Domingo pueblo near Wallace station, A., T. & S. F. R. R.), a province of Indians called Hubates (old pueblos, Santa Fe County), near mountains full of pine and cedar, who received them peaceably and gave them great store of victuals, informing them also of very rich mines which they found, whereout they got glistening and good metal and therewith returned to the town from whence they came."

That the mines of New Mexico were worked by the Spaniards to a considerable extent is amply attested in old abandoned shafts to be found all along the mountains from the Santa Fe range to the Organs, and elsewhere. They were worked by the Pueblo Indians under duress, from which imposed labors the latter revolted in 1680, drove their oppressors out of the country, and kept control of the same for a number of years. Terms of peace were finally made and the Spaniards returned under stipulations that in their occupation of the country the pursuits of the people were to be confined to agriculture and stock. As a consequence, for many years, mining was wholly abandoned, and but little attention has been given to mining in New Mexico until a comparatively recent date.

Since the American occupation (1846), as reported by the Director of the United States Mint, the net production in precious metals of the mines of New Mexico down to and including 1881, have been in gold, $10,350,000, and of silver, $3,622,000; making a total of $13,972,000.

The real general development of the mineral resources of the Territory only commenced less than five years ago. It was not until geological and mineralogical surveys had been made and reported by the general government, and the coming of railroads and convenient transportation had become an assured fact, that development commenced in real earnest. Sufficient has thus been demonstrated at the beginning of 1883 to clearly establish beyond doubt that new Mexico is one of the richest and most permanent in mineral resources of all the States and Territories. That there are within its borders several mines entitled to rank among the most remarkable and richest in yield in the known world, and that there is still not only a broad and most inviting field for the investment of capital, but that the chances for the prospector are equal or better, if possible, than any of the developed finds that have preceded.

The writer does not hesitate to predict that New Mexico is on the eve of one of the most remarkable seasons of prosperity, as represented in its mineral resources, that has ever fallen to the lot of a mineral-bearing section, and presents the following facts as earmarks of the truth of the statement asserted:

Generally the resources of the Territory consist very largely of not only its mines of precious metals, but likewise of copper, lead, manganese, and iron, besides mica, salt, coal, gypsum, soda, lime, kaolin, cement, sulphur, plumbago, mineral paints, marble, and

building stones. Precious stones, such as turquoise, garnet, moss agate, and emerald, are found. Valuable mining properties are found in every county.

Iron, lead, and coal are practically inexhaustible. The coal fields of Raton and of Colfax County generally, and the San Juan River, near Tierra Amarilla, on the Cerrillos, and on the Rio Galisteo, near Santa Fe, Bernallo, on the line of the Atlantic and Pacific Railroad, near San Antonio, on the Atchison, Topeka, and Santa Fe Railroad, and in Grant, San Miguel, and Lincoln Counties, are immense.

There can be no question as to New Mexico being able to produce vast quantities of minerals, including the precious metals, which are found in nearly every county; 132 mining districts are enumerated in Ritch's Handbook. The total deposits of New Mexico, gold and silver, in United States Mints, to June 30, 1883, were:

Silver	$4,631,710 66
Gold	1,782,773 19
	$6,414,483 85

The total yield, according to H. C. Burchard, Director of the Mint, including 1883, was as follows:

	Gold.	Silver.
To 1881, inclusive	$10,350,000	$3,622,000
1882	150,000	1,800,000
1883	280,000	2,845,000
	$10,780,000	$8,267,000
Total		$19,047,000

These figures show that in New Mexico, as in all other gold and silver producing countries, the gold yield is steadily decreasing, while that of silver is increasing. This has always been the case in new countries since man learned to extract metals from their ores. The physical properties of gold, mentioned elsewhere, cause that metal to be always in the metallic state in nature. Certain geological influences set it free from the rocks in which it was stored, and cause it to collect in placers from which it is quickly gathered when discovered. The source of the gold is then sought, when it is found that silver is more abundant than gold and more easily obtained. This was the case after the conquest of America by Spain. The conquerors, who cared only for gold, found silver in unexpected abundance. The result was a glut of silver after one of gold, the consequences of which are recorded in history.

The mineral exhibit made by New Mexico at the Exposition was ample and even grand. There were large piles of ores on terraced tables from Socorro County, each of which contained from one to two cubic feet. There were 275 of these piles. The ores were *silver*, *iron*, *copper*, and *lead*, with *gypsum*, *salt*, *sand carbonates* (like those of Leadville, Colorado), *magnetite* (loadstone), *baryta*, *hematite*, *fluorspar*, *fire clay*, *etc.*

There were fine blocks of coal, and piles of coke of excellent quality from Bloomsbury, Colfax County, and from Socorro and other counties. The possession of this fuel gives to New Mexico a very great advantage in ore smelting and metallurgy. Limestone suitable for a flux is also abundant.

Lead bullion in large quantities was exhibited by the Smelting Works of the Socorro and the Billings Smelting Works. In this exhibit slabs of fire-proof stone and talc were shown.

A fine specimen of black tourmaline in mica and mica schist was also shown, and views of scenery, towns, hydraulic mining, machinery, etc.

WASHINGTON TERRITORY.

Territory, March 2, 1853. Area, 69,994 square miles. Population in 1880, 75,116. Capital, Olympia. Floor space in Exposition, 2,585 square feet. The mineral resources of this Territory are scarcely known. Gold has been largely produced. The yield to 1868 was estimated by J. Ross Browne at $10,000,000, but this is now thought to be in excess of the reality. Since that date the yield has steadily diminished. In 1883 the yield of both the precious metals is estimated by the Director of the Mint at:

Gold	$80,000
Silver	500
	$80,500

The total deposits of the precious metals in the Mints of the United States to June 30, 1883, were:

Gold	$285,635 21
Silver	681 37
	$286,316 58

Coal, iron, and building stones are found in the Territory. The coal is of a high grade of brown coal or lignite, suitable for many purposes, and is largely mined and exported.

WYOMING TERRITORY.

Territory, July 25, 1868. Area, 93,107 square miles. Population in 1880, 20,789. Capital, Cheyenne. Floor space in Exposition, 3,325 square feet. The surface of the Territory is generally high and mountainous. The mean altitude is 6,450 feet. The Rocky Mountains cross the Territory in a northwest and southeast direction. There is a large area of fertile land in the Territory suitable for agriculture and pasturage.

One of the most interesting features of the Territory is the Yellowstone Geyser region, which has been reserved as a national park. The most valuable minerals found in Wyoming are *coal* and *iron*. *Some* gold has been taken from the mines, but the yield has not been great. Up to June 30, 1883, the deposits in United States Mints were:

Gold	$729,895 57
Silver	11,830 01
	$741,725 58

The coal, which is a good quality of lignite, probably tertiary, is found in extensive fields. It is an excellent fuel for many purposes, but it will not make good coke, and is therefore unsuited for iron smelting. The estimated output of Wyoming coal from 1868 to 1882 inclusive, according to Albert Williams, Jr., was 4,585,594 tons of 2,000 pounds. The following is from a recent mining publication:

WYOMING COAL FIELDS.

These begin from three to thirty-seven miles north of Rattlesnake Hill, whence coal is found for 150 miles to the north. Two miles or so north of section 4, township 32, range 68, is a great belt of lignite coal a little harder than the Colorado, though much like Rock

Spring coal. It extends seventy miles east and west, with the Wind River Mountains as the western boundary, and is well up into Montana. The biggest field is in the northern part of Rattlesnake Basin, where there are fifteen veins, one being ten feet, two five feet, and one four feet thick; all lying on top of one another, while any quantity of veins are two feet thick. This supply, covering so large a territory, seems to be inexhaustible. It of course greatly cheapens the cost of sinking oil wells to have fuel for the boilers right at the doors, and no cost to speak of for hauling. The Colorado and Wyoming Company, a Denver corporation, has already expended $20,000 in developing their oil and coal tract, which embrace 6,560 acres in the Rattlesnake and 640 acres in the Seminole regions.

Wyoming made a splendid collective exhibit at the Exposition, but the mineral section was not large. The following were the most interesting minerals shown:

Coal in large blocks from Rock Springs, Sweetwater County, and from the Alma Mine, Unita County, and from the Carbon Mine: *petroleum shale; alabaster*, or massive gypsum; *carbonate of soda*, crude; *red hematite* (large quantity): *kaolin; mica*, of inferior quality; *moss agate; silicified wood.*

A special case containing minerals from Yellowstone Park Geysers; bottles, horseshoes, and wire baskets incrusted with silica; *amethyst crystals* and *quartz crystals* in *silicified wood*, or casts of logs; *agate chalcedony.* There was a small case containing a hollow cylinder of quartz formed in space left by a decayed branch of a tree. The inside was covered with magnificent quartz crystals. The length of this rare and beautiful specimen was about 14 inches, and the diameter about 10 inches. The rather small mineral collection of Wyoming was beautified and augmented by a fine set of large photographs representing views of scenery, towns, geysers, etc.

The Territories of *Alaska* and *Utah* were not represented, except to a limited extent in the United States Government exhibits. They are both mineral-producing Territories of great importance, both of which could have made fine exhibits if so disposed.

THE UNITED STATES GOVERNMENT EXHIBITS

Occupied a central space in the Government Building, 109,325 square feet. The following general description of this exhibit is from the *Times-Democrat Almanac for 1885:*

THE UNITED STATES EXHIBITS.

The display made by the Government of the United States is the largest and most delightfully instructive ever yet attempted by any nation officially.

The expenditure of the money appropriated by the Government, amounting to $300,000, and the preparation of exhibits, was intrusted to a Board of Commissioners, consisting of Col. S. C. Lyford, War Department; Chas. S. Hill, Department of State; Lieutenant B. H. Buckingham, Navy Department; Wm. F. McLennan, Treasury Department; Hon. A. D. Hazen, Post Office Department; Hon. Ben. Butterworth, Interior Department; Cecil Clay, Department of Justice; Wm. Sanders, Department of Agriculture; and Prof. G. Brown Goode, Smithsonian Institute (including the National Museum and United States Fish Commission).

STATE DEPARTMENT.

The principal feature of the exhibit of the State Department is an immense globe, fifty feet in diameter, upon which is accurately delineated all the geographical and political divisions of the earth, with facts as to their area, population, productions, etc. The globe is so constructed as to be illuminated from within.

Upon large illustrated charts and diagrams is presented to the eye information relative to the production, manufactures, trade, and commerce of each country, and upon other charts are shown the relative distance of the various ports of Central and South America from the various shipping ports of the United States, as compared with the distances of those same ports from those of Europe.

TREASURY DEPARTMENT.

The Treasury Department has a life-saving station upon the shore of Lake Rubio, the crew being provided with all the boats and life-saving apparatus used by them in actual service.

The Bureau of Engraving and Printing is represented by specimens of all work ever done by the Government in that line.

The Mint Bureau exhibits a complete collection of all the coins of all denominations ever issued by the United States.

THE WAR DEPARTMENT

Represents the character of the work of the medical staff of the army in peace and war, by exhibiting every means and appliance used in caring for the sick and wounded or the amelioration of human suffering.

This is done by exhibiting the objects themselves, by models or by drawings and photographs. Ambulances, stretchers, panniers, and other means for transporting the sick and wounded, surgical instruments and appliances, artificial limbs, and everything upon the medical supply tables are displayed, the immense collection contained in the army medical museum having been freely drawn upon to make this exhibit especially interesting to the physician and the student.

The exhibits of

THE INTERIOR DEPARTMENT

Exceed in magnitude, variety, and interest those of all the other departments.

Although by no means the largest, one of the most attractive exhibits is that of the General Land Office.

This consists of a series of about fifty large maps, beautifully executed and handsomely framed, showing the surveys and sale of the public lands from the organization of the Government till now.

A series of large maps shows in colors all the developed mineral areas and specific fields in the United States.

Another series of maps illustrates the advancement, by decades, of the railroad system of the United States from 1830 to 1884.

A series of fifty large water color paintings illustrates pictorially the progress in mining from the most primitive methods—from naked aborigines pounding the gold-bearing quartz with a stone to a view of the ponderous stamp-mills of to-day.

But by far the most valuable feature of this exhibit is the splendid collection of mineral specimens taken since September from the principal mines and quarries in the United States.

THE PATENT OFFICE.

A careful selection of between five and six thousand models has been made from among the millions in possession of the Patent Office, and so arranged as to illustrate the gradual progress in each line of invention from the most primitive process to the perfected machine of to-day.

THE NAVY DEPARTMENT

Illustrates the perils and hardships of Arctic navigation by its display of the Greely expedition. This display includes everything brought back by former expeditions or in possession of the Government, derived from other sources, such as dresses worn by the native Esquimaux and the Arctic explorers, sledges and dog-teams, implements used by the natives in hunting and fishing, etc. Sailors who accompanied the relief party, and who had previously had much experience in Arctic navigation, are constantly in attendance upon this exhibit for the purpose of giving all desired information.

The Bureau of Construction and Repair exhibits models of various vessels of the navy, including those now being constructed. Samples of all the cordage used in the navy, from a ten-inch hawser to the finest twine; blocks and tackle of such ponderous proportions as a Brobdignag might use to pull a mountain from its base to a tiny block that a Lilliput would employ to hoist a fly.

The Naval Observatory shows a full line of astronomical and nautical instruments, chronometers, etc. An astronomical clock, located in the Main Building, is electrically connected with the astronomical clock in the Naval Observatory in Washington, from which it will take its time to a fraction of a second at 12 o'clock daily. This clock is electrically connected with clocks placed in all the buildings on the grounds.

THE AGRICULTURAL DEPARTMENT

In its chemical division illustrates sugar production, more particularly that from the sorghum, or Chinese cane.

A complete sugar laboratory is shown and explained by practical manipulation conducted by an expert, and a full line of sorghum sugars as well as of candy and other manufactures therefrom produced.

THE BUREAU OF ETHNOLOGY

Exhibits many thousand specimens of pottery, stone implements, and shell and bone ornaments recovered from the soil and found in the caves of the ancient cliff dwellers of the cañons of the Colorado and Yellowstone.

THE GEOLOGICAL SURVEY.

A branch of the Interior Department, presents models and dissection of the Comstock, Eureka, Leadville, and other mines, showing their depth, extent, and method of working.

THE SMITHSONIAN INSTITUTE

Having turned over its vast collection to the new National Museum, confines itself to showing its publications, to which will be added a case containing all the scientific publications by the government within the past twenty years, more than 900 volumes. The exhibit of

THE FISH COMMISSION

Is extensive and interesting. The operation of artificial hatching, culture, and distribution of fish is practically exemplified. All the boats, tackle, and apparatus for taking fish, together with an immense series of large photographs and beautifully colored pictures and models, representing to the life every fish that swims, are displayed.

THE NATIONAL MUSEUM

Exhibits, under animal products, the stuffed and mounted skin of every beast, bird, and fish that contributes in any way to the life, comfort, or pleasure of mankind.

In connection with each specimen is placed specimens of every product derived therefrom, and how applied to man's use; such as its flesh for food, its skin, hair, and fur or feathers for clothing, its feathers or scales for ornament, its horns, bones, hoofs, and teeth for their innumerable uses in the arts and manufactures, until every part of the animal economy is shown by its derivative products and their various applications to be finally consumed by all-devouring man.

The mineral exhibit includes all building stones found in the United States, exhibited in four-inch cubes, a natural fracture on one face, a hammered surface on another, and a polished surface on a third.

The department of conchology shows the largest and most beautiful collection of shells ever made, the finest collection in America having been purchased from Prof. R. E. C. Stearns, of California, specially for this exhibit.

This department exhibits for the first time mammoth photographs more than four times the size of any that have ever been made in the world, printed from a single negative upon one piece of paper. The space covered by the photographic print is five by seven feet; when framed, seven by nine feet. They number thirteen, and represent the government buildings at Washington.

THE GEOLOGICAL SURVEY

Furnishes a number of striking models of the more important geologic and topographic features of the Far West. The Grand Cañon of the Colorado, the Yellowstone Park, the Yosemite Valley, and the great mountain districts of the Rocky Mountains are shown; also a number of models of the great mines of Colorado, Nevada, and California, and mammoth transparencies, 150 in number, illustrating chiefly the people and the scenes of the Far West.

THE POST OFFICE DEPARTMENT

Has a model Post Office in the Government Building, where mails are received, dispatched, and delivered at all hours during the continuance of the Exposition. It displays samples of all the mail bags, pouches, and other paraphernalia connected with the mail service. A very attractive feature is a collection, handsomely mounted and framed, of all the postage stamps and stamped envelopes ever issued by the United States, and also of those issued by several foreign governments. A model postal car on the grounds illustrates the method of taking up and delivering mail bags at way stations by lightning express trains.

The mineral collections from the Smithsonian Institution and the National Museum were specially fine. They are fully described in the following catalogue, published by the department:

INTERIOR DEPARTMENT. SMITHSONIAN INSTITUTION—UNITED STATES NATIONAL MUSEUM.

PLAN TO ILLUSTRATE THE MINERAL RESOURCES OF THE UNITED STATES AND THEIR UTILIZATION, AT THE WORLD'S INDUSTRIAL AND COTTON CENTENNIAL EXPOSITION OF 1884–1885, AT NEW ORLEANS.

By FRED. P. DEWEY, *Curator of Economic Geology and Metallurgy.*

In the first division of this collection—that of economic geology, or the natural occurrence of materials of economic value—it is designed to exhibit collections illustrating the different kinds and grades of the ores of each metal, and also a few collections of nonmetallic minerals of economic importance.

In the second division—that of metallurgy—it is designed to exhibit collections representing the processes for the extraction of the metals from their ores by specimens, where practicable, filling the gaps by means of illustrations and descriptions, and accompanying them by general illustrations and descriptions so as to fully explain these processes.

In making up the ore collection it has been designed to represent all the different varieties of each ore and many of the most prominent mining regions, so as to give a good general idea of the nature of the occurrences of the metals and also their distribution, but it has not been possible to show every occurrence of each variety of an ore, neither has it been possible to represent every mining region.

The Lake Superior copper region is very thoroughly represented, both on account of the value of the mines of this region and as representing the kind of collections it is desirable for the museum to possess to illustrate a region or a mine.

Taking, first, the region, it is represented by three prominent mines showing three different and characteristic occurrences of the ore.

First, the so called Mass mines, which are characterized by the occurrence of large masses of free copper, amounting in some cases to many tons of metal in a single mass, are represented by the Central Mine. Besides these large masses these mines also carry considerable disseminated free copper.

Second, the Amygdaloid mines, which are characterized by the occurrence of the free copper in amygdules, bunches, strings, and sheets from the size of a pin-point up to a few hundred pounds in weight (with rarely a large mass) disseminated in a soft amygdaloid trap-rock, are represented by the Osceola Mine.

The average percentage of copper in the ores from these mines varies from three quarters of 1 per cent to 2 per cent.

Third, the Conglomerate mines, which are characterized by the occurrence of the free copper mostly in strings in a hard conglomerate of ferruginous quartz pebbles, are represented by the Conglomerate Mine. The average percentage of copper in the ores from these mines varies from 4 per cent to 6 per cent.

Taking the Conglomerate Mine, the collection shows, first, the general character of the ore and the inclosing wall rocks; secondly, it shows the occurrence of the ore at various prominent points in the mine which are accurately located; and, thirdly, it shows a section of the rocks over a distance of 631 feet, by specimens taken at suitable distances to show the different characters and changes of the material.

In selecting specimens it has not been designed to take those that are especially handsome or rich, but rather to take such as represent the actual character, occurrence, and value of the ores. In making collections of ores for the National Museum, it is very desirable that some definite and systematic plan of representation of this kind should be adopted, as collections made in this way have far more value for museum purposes than the haphazard collections of showy specimens usually found in such establishments.

COLLECTIONS IN ECONOMIC GEOLOGY.

Gold.

Placer gold, from Virginia, North Carolina, California, Idaho, Montana, Utah, and Oregon.

Gold quartz from Virginia, North Carolina, South Carolina, Georgia, California, and Montana.

Auriferous gravel from California and South Carolina.

Auriferous pyrite from Virginia and Colorado.

Telluride ores—compounds of gold with tellurium from Colorado.

Iridium.

Iridosmine, from California.

Silver.

Native silver with native copper, from the Lake Superior region.

Native silver on sulphide of copper, from Montana.

Wire silver, from Nevada, Montana, Idaho, and New Mexico.

Native silver and horn silver, in sandstone, from Utah.

Horn silver, from Colorado, Utah, Nevada, and New Mexico.

Ruby silver, from Nevada.

Base ores carrying silver (milling ores), from Nevada, Utah, and Montana.

Argentiferous lead ores (smelting ores), from Colorado, Utah, and Nevada.

Tin.

On account of recent discoveries and the general interest attaching to tin, the list of the localities of the occurrence of cassiterite, or the binoxide of tin, has been made as complete as possible, and includes Maine, New Hampshire, Virginia, North Carolina, Alabama, Montana, and the Black Hills of Dakota. The tin ore of San Jacinto, California, is also shown.

With the tin ores are shown bars of tin reduced from the New Hampshire (1840), Virginia, Alabama, Montana, and California ores; also, a collection of Welsh tin plate.

Antimony.

The sulphide ores, from Utah (with metal) and California.

Quicksilver.

Cinnabar, from California.

Lead.

The sulphide ores, from Missouri. (For argentiferous lead ores, see under silver.)

Copper.

Native copper, from Lake Superior region in Michigan, including water-worn or surface specimens; specimens of the mass copper and chips obtained in cutting up the masses in the mine; and specimens showing the disseminated free copper in the rock, both amygdaloid and conglomerate. To these are added specimens illustrating the dressing of the ores.

Sulphide ores, including the sulphides of copper and iron, from Vermont, Maryland, North Carolina, and Missouri, and the sulphide of copper, from Butte, Montana.

Oxidized ores, from Pennsylvania, Virginia, and Arizona.

Bismuth.

The oxidized ores, from Utah.

Nickel and Cobalt.

The sulphide ores from Pennsylvania and Missouri.

Iron.

A collection of ores of over 500 specimens, selected from the collections made by the Tenth Census, under the direction of Professor R. Pumpelly, to illustrate the iron industry of the United States, showing all the different kinds and varieties of iron ore found in this country.

This collection is not intended to show the full occurrence in any one region, but only the prominent varieties of the different regions.

Manganese.

Manganese ore from Virginia and Georgia.

Zinc.

The New Jersey ores, includiug franklinite, zincite, willemite, and calamine.

The silicate and carbonate ores of Tennessee and Virginia.

The sulphide ores of Missouri and Kansas.

Coal.

A collection showing the different varieties of coal from Pennsylvania and Virginia, including anthracite, semi-bituminous, bituminous, splint, and cannel coal; also a large collection illustrating the methods of coal mining, including some large photographs (taken by electric light) of the interior of a coal mine, showing the formation of the coal seam and its peculiarities, together with the men at work. These are the first photographs ever taken of the interior of a coal mine.

Sulphur.

Native sulphur from Nevada.

Iron pyrites from Massachusetts and Virginia.

Besides the above systematic ore collections, some illustrations of ores will be found in the metallurgical collections.

In making up the metallurgical collection it has not been possible to exhibit the production of each metal exhaustively, owing to the small amount of suitable material previously in the department, and to the short space of time available for making new collections.

A few systematic illustrations of metallurgical operations are shown. In making these collections it has been designed to treat a few subjects thoroughly rather than a large number superficially. After suitable consideration a few representative works were selected for illustration, and have been worked up as completely as possible.

Beginning with the ore, as mined, each step in its preparation for smelting is shown, together with the by or waste products of such treatment. To illustrate the smelting operation, the ores, the fuels, the fluxes, and every other material entering into the operation are shown. Following through the process, each product of each operation up to the final product of the works is represented; to these are added, where practicable, illustrations of materials of construction, such as fire-clays, sands, etc. The furnaces and tools are shown by specimens, views, and descriptions. The interest and value of these collections does not lie so much in the specimens themselves as in their being thoroughly connected, and in the kind and amount of information that can be given in regard to them.

In order to be satisfactory the series must be complete, and the information full and accurate. A great deal of time, care, and attention is necessary in making such a collection.

To illustrate the nature and scope of these collections, a single one, that from the Passaic Zinc Works, will be described in detail. These works are located at Jersey City, New Jersey, and use the zinc, iron, and manganese ores from Franklin, Sussex County, New Jersey. They were started in 1854 and have been twice enlarged.

From 1854 to 1875 only oxide of zinc was manufactured; in 1875 the spelter furnaces were added, and in 1884 the spiegel furnace. The works have been in constant operation from the very beginning.

There are 48 furnaces, 6 by 4 feet, making oxide of zinc, arranged in double rows of 8 and 10. There are 12 spelter furnaces arranged in blocks of 4 each. The spiegel plant consists of one 9 feet 8 inches by 37½ feet blast furnace.

The Franklinite ores are treated first in the oxide furnaces for the production of oxide of zinc and the residues, containing iron and manganese, are smelted in the blast furnace for the production of spiegel.

The silicate and carbonate ores are smelted in the spelter furnaces for the production of metallic zinc.

The collection from the zinc furnaces shows:

The franklinite ore, consisting of a mixture of franklinite or protosesquioxide of iron with zinc and manganese replacing the iron, zincite or oxide of zinc, willemite or silicate of zinc, calcite or carbonate of lime, in lumps as mined, from the Buckwheatfield Mine, Franklin, Sussex County, New Jersey.

The same ore crushed ready for the furnace.

The franklinite ore, consisting of a mixture of franklinite or protosesquioxide of iron with zinc and manganese replacing the iron, zincite or oxide of zinc, willemite or silicate of zinc, rhodonite or silicate of manganese, and calcite or carbonate of lime, in lumps as mined, from the Sterling Hill Mine, Ogdensburg, Sussex County, New Jersey.

The same ore crushed ready for the furnace.

The silicate and carbonate ore, consisting principally of calamine or hydrated silicate of zinc with a little carbonate of zinc resulting from decomposition, in lumps as mined, from the Sterling Hill Mine, Ogdensburg, Sussex County, New Jersey.

The same ore after roasting to expel water and carbonic acid.

The roasted ore crushed ready for the furnace.

Anthracite coal used for heating purposes.

Anthracite coal (fine) to be mixed with the ore in making up the charge to reduce the zinc to the metallic state.

The mixed charge of Franklinite ore and coal ready for the oxide furnace.

The mixed charge of silicate and carbonate ore for the spelter furnaces.

The residuum remaining in the oxide furnace after the extraction of the zinc.

The oxide of zinc produced.

The residue remaining in the retorts after the distillation of the zinc in the spelter furnaces.

Blue powder, a by-product consisting of a mixture of metallic zinc and oxide resulting from imperfect condensation of the zinc.

The spelter or metallic zinc produced.

To these are added the fire-clay from Woodbridge, N. J., used for making retorts.

A piece of new retort.

A piece of old retort.

Old retort ground, to be mixed with the clay in making new retorts.

The collection from the spiegel furnaces shows:

The residuum from the oxide furnaces, containing iron and manganese.

Limestone used for flux, from Sing Sing, New York.

Anthracite coal used for fuel.

The slag produced.

Oxide of zinc deposited in the gas-flues.

The Spiegeleisen produced.

The collection of specimens is supplemented by photographic views of the principal points about the works.

COLLECTIONS IN METALLURGY.

Gold.

The extraction of the free gold from the auriferous gravel of California by amalgamation: Collection from the North Bloomfield Mine, Nevada County, California.

The extraction of the free gold from the auriferous pyrite in quartz of Colorado, by stamping and amalgamating: Collection from the Bobtail Mill, Black Hawk, Gilpin County, Colorado.

The extraction of gold from the auriferous mispickel (arsenical pyrites) by roasting and chlorination: Collection from the Del Oro Works, Canada.

The extraction of gold and copper from auriferous copper ores, by the fusion and electrolitic process: Collection from the works of E. Balbach & Son, Newark, New Jersey.

The manufacture of gold leaf: Collection from Hastings & Co., Philadelphia, Pennsylvania.

Silver.

The extraction of silver from base ores by chlorodizing, roasting, and milling (amalgamation): Collection from Ontario Mill, Park City, Summit County, Utah.

The smelting of argentiferous lead ores and the refining of the base bullion (silver and lead): Collection from the Cheltenham Works, Saint Louis County, Missouri.

The refining of base bullion (silver and lead): Collection from the works of E. Balbach & Son, Newark, New Jersey.

Lead.

The manufacture of pig lead and white lead direct from the ore: Collection from the Lone Elm Works, Joplin, Missouri.

Copper.

The smelting and refining of copper by the fusion process: Collection from the Baltimore Copper Works, Baltimore, Maryland, and Saint Genevieve Copper Works, Saint Genevieve, Missouri.

The refining of pig copper: Collection from the Ansonia Brass and Copper Works, Ansonia, Connecticut.

The rolling of copper: Collection of the Ansonia Brass and Copper Works, Ansonia, Connecticut.

Iron.

The smelting of pig iron: Collections from the Crown Point furnace, Crown Point, New York, the Rockwood furnace, Rockwood, Tennessee, and the Missouri furnace, Saint Louis, Missouri.

Steel.

The manufacture of crucible steel: Collection from the Crescent Steel Works, Pittsburgh, Pennsylvania.

The manufacture of Bessemer steel: Collection from the South Chicago Bessemer Works, South Chicago, Illinois.

Zinc.

The smelting of spelter or zinc: Collections from the Glendale Zinc Works, Saint Louis, Missouri, the Joplin Zinc Works, Joplin, Missouri, and the Rich Hill Zinc Works, Rich Hill, Missouri.

Zinc, Iron, and Manganese.

The smelting of spelter or zinc, oxide of zinc, and spiegeleisen from Franklin, New Jersey, ores: Collection from the Passaic Zinc Works, Jersey City, New Jersey.

Coke.

The manufacture of coke at Connellsville, Pennsylvania: Collection from the H. C. Frick coke ovens.

Sulphur.

The manufacture of sulphuric acid from iron pyrites: Collection from the Merrimac Chemical Company, Boston, Massachusetts.

The manufacture of Alloys.

Brass and its utilization: Collection from the Ansonia Brass and Copper Works, Ansonia, Connecticut.

Type metal and its utilization: Collection from the type foundry of Mackellar, Smiths & Jordan, Philadelphia, Pennsylvania.

Babbitt, or anti-friction metals: Collections from Merchant & Co., and Paul S. Reeves, Philadelphia, Pennsylvania.

Solders: Collection from Merchant & Co., Philadelphia, Pennsylvania.

COLLECTION ILLUSTRATING THE PRACTICAL APPLICATION OF NON-METALLIC ORES.

The manufacture of sandpaper: Collection from Baeder, Adamson & Co., Philadelphia, Pennsylvania.

Asbestus and its application: Collection from the H. W. Johns Company, New York.

Abrading and polishing materials: Collections from R. J. Waddell & Co., New York, and Saint Louis Tripoli Company, Saint Louis, Missouri.

The utilization of barites: Collection from Page & Krause, Saint Louis, Missouri.

In the War Department, Medical Department of the United States Army, were shown some remarkable photographs of diatoms, by Colonel J. J. Woodward, as follows: Amphipleura pellucida, magnified 3,500 diameters; Arachnoidiscus, 1,200 diameters; Coscinodiscus, 2,200 diameters; Heliopelta, 1,000 diameters; Navicula rhomboides, 3,000 diameters; Navicula lyra,

1,650 diameters; Pleurosigma angulatum, 800 diameters; section, 6,000 diameters, showing hexagon, another showing beads, one section, 23,000 diameters, very fine; Surirella gema, 3,200 and 4,500 diameters; Triceratium fimbriatum, 1,000 diameters; T. farus, 1,000 diameters.

Dr. George M. Stemberg, F.R.M.S., exhibited splendid photographs of navicula lyra, 1,800 diameters; Triceratum fimbriatum, 1,500 diameters.

DEPARTMENT OF THE INTERIOR.

The General Land Office exhibited two large cases of ores—specimens taken from mines for which patents were applied for. They were from different parts of the United States. Iron ores and other large mineral specimens were placed on pedestals or bracket shelves. Earthy minerals and salt were shown in bottles. In this department was exhibited a large oil painting of Sutter's Mill, and smaller ones of miners working, painted by Eastman, of San Francisco. There were also 12 oil paintings of mining scenes and sections of quartz mines.

The Commissioner of Railroads made a small exhibit of slates, marbles, building stones, coal, iron, etc.

RAILROAD COMPANIES.

A number of railroad companies made exhibits special, or jointly with the States they traverse. These have been generally mentioned in describing the State mineral exhibits. California is much indebted to the Southern Pacific Railroad for the success of the State exhibit; and other States were likewise indebted to local railroad companies. In the Government Building there were two great railroad exhibits that did not occupy State space—the Cincinnati and New Orleans, or Queen and Crescent, and Texas Pacific and the Richmond and Danville and East Tennessee and Georgia. The space occupied by the former was 10,125 square feet, and by the latter, 12,045 square feet.

The Queen and Crescent made a large and comprehensive exhibit of mineral products of the States through which their roads pass. All the exhibits were in exceptionally large quantities, consisting of *marls*, *phosphatic fertilizers*, *iron ores*, *fire and brick clays*, *limestones*, *pig iron*, *coal and coke*, *manufactured iron*, *Caen stone*, *hematite and limonite*, *building stones*, *marbles*, *steatite*, etc.; one mass of iron ore weighing 10,000 pounds from Gadsden, Alabama—an imposing series—but all the minerals were shown also by the respective States.

The Richmond and Danville made an exhibit remarkable alike for the quantities of each mineral shown, the numerous localities represented, and the choice specimens obtained and displayed. The whole collection was well arranged, well labeled, and kept scrupulously clean. The collections were in charge of C. C. McPhail, of Richmond, Virginia, assisted by William Beal, of Murphy, Cherokee County, North Carolina. To these gentlemen I am indebted for much information and for favors shown.

The bulk of the collection was placed on large tables in generous piles. This part of the display consisted of *asbestus; barite; building stones; black band iron ore; corundum; chromic iron; copper ores; chalcopyrite; coal and coke; diatomaceous earth; gold ores*, from many mines; *iron ores; kaolin; limestone; limonite; lead ores; marble; magnetite; molding sands; manufactured iron; nickel ore; ochre; pyrites; pig iron; slate*, etc. The same minerals were also shown in State collections and have been generally described.

The choicer minerals were shown in plate glass table cases, which con-

tained some of the rarest, choicest, and most beautiful specimens shown at the Exposition, among which were the following:

Albite, moonstone, Virginia.
Asbestus, South Carolina.
Beryl, Virginia.
Biotite, crystal in sheet of muscovite; very fine. The biotite was ¾ inch long, clear cut angles. Rabry Mine, Macon County, North Carolina.
Calcite crystals, from Tennessee.
Cassiterite, North Carolina.
Chalcopyrite. Specimen weighed 200 pounds, nearly pure. North Carolina.
Chromic iron, North Carolina. This much resembles the California mineral. Mr. McPhail thinks that 6,000 tons are lying on the dumps in Yancey and Madison Counties.
Coal, Tennessee and Alabama.
Columbite, Virginia.
Copper, native, in cuprite.
Corundum, many fine varieties in special series from North Carolina.
Epidote, fine, North Carolina.
Fluorspar and *Fergusonite*, both from Virginia.
Garnets in fine large crystals, North Carolina.
Genthite, North Carolina.
Gold in many varieties of occurrence. Large nuggets from Pigeon Roost placers, Georgia. In quartz, Dahlonega, Georgia. In beautiful crystals, ochohedrons on wires or threads of gold, Lumpkin County, Georgia. Many specimens of less interest from other southern localities.
Hematite, fine, Alabama.
Hiddenite, North Carolina.
Itacolumite, North Carolina.
Leopardite, very fine, North Carolina.
Marbles in many beautiful varieties from numerous localities. A specially fine exhibit of Tennessee marble, and slabs highly polished from Georgia and Alabama.
Mica, remarkably fine specimens from North Carolina.
Microlite, Virginia.
Monazite, North Carolina.
Pyrophyllite, small crystals on slab, Georgia.
Pyrolusite, from Virginia and North Carolina.
Pyroxene, with chalcopyrite, fine, Dicktown, Tennessee.
Quartz in many beautiful and some rare varieties and *doubly terminated* crystals, North Carolina.
Crystals with many inclosed air globules, very fine, and *crystals* containing rutile crystals or chlorite, North Carolina.
Quartz pseudomorph, called box quartz, fine, North Carolina.
Rutile, very fine lustrous crystals, and the same mineral imbedded in quartz, North Carolina.
Samarskite, North Carolina.
Siderite, fine, North Carolina.
Steatite, used in paper manufactures, North Carolina.
Staurolite in fine crystals, North Carolina.
Tourmaline, black, Georgia and Virginia.
Zircon, North Carolina.

A. E. Foote, of Philadelphia, made a fine display of minerals and scientific publications in the Government Building. The collection was very large, and contained many rare and beautiful specimens, but they had no local interest as they were collected from all parts of the South. All the specimens and books were for sale.

GALLERIES.

There were but few minerals exhibited in the galleries of the Government Building. Near the south central staircase were shown several collections for educational use, placed together and in competition—a reward having been offered for the best and cheapest collection for schools. Centrally in the east gallery, over the Smithsonian headquarters, was Ward & Howell's grand collection of museum material, including many specimens of minerals from various parts of the world—fossils, rocks, ores, and casts and models of rare fossils, relief maps, etc. Ward & Howell, of Rochester,

New York, are dealers in this class of merchandise. They furnish colleges and educational institutions, or will sell a single specimen, if preferred. On the north side the colored people made their special exhibits, including minerals. In this department South Carolina, Louisiana, Colorado, New Mexico, and California had small collections of minerals.

On the south side France made an educational exhibit, in which minerals, rocks, ores, crystals, etc., were shown; also geological maps and publications. In the Connecticut gallery some broken fragments of marble were beautifully painted. In the California woman's department, in the gallery over the California headquarters, a small collection of minerals was shown.

BRICKS AND TERRA COTTA.

Well burned bricks are the most durable and convenient of building material. The old method of hand making has been superseded by costly and complicated machines, which do the labor of many hands, and in proportion, cheapen the product. The brick making machines were in an annex on the west side of the Main Building. I examined them with much interest. Good bricks cannot be made from inferior materials, no matter how good the machine may be. On the other hand, the best of material must be properly tempered and mixed to produce good bricks—this is the duty of the brick machine in the hands of the skilled workman. Fortunately, good clays, suitable for making the best of bricks and terra cotta ware, are common almost everywhere where there is soil. Clay that will make good pressed bricks will make the best quality of terra cotta if the color is no consideration, and similar machines mold the most beautiful designs with great rapidity. This is why this new building material is so cheap and so extensively used in the Eastern States. Some of the brick machines at the Exposition used dry clay, which is prepared by grinding and sifting before being pressed. The Eureka Dry Press Machine makes 2,500 bricks per hour. The pressure employed is equal to 50,000 pounds. The power used to work the machine to advantage is 40-horse power. The bricks are ready for the kiln when they leave the machine. The bricks made are said to be of the best quality.

Chambers & Brother, of Philadelphia, exhibited a machine that thoroughly mixed the material and forced a ribbon of tempered clay from an orifice in the tempering machine, which was cut off into bricks at the rate of 66 per minute. The brick are not so smooth as pressed brick, but more so than those hand made. The machine is guaranteed to make 45,000 brick in 10 hours. It requires a steam engine with a 12-inch cylinder.

J. W. Penfield & Sons, of Willoughby, Ohio, exhibited a machine for making brick, ornamental tiles, clay pipes, and other ware. It somewhat resembled the Chambers machine. By changing the dies, hollow bricks, tubes, or pipe, wedge shaped brick, and ornamental terra cotta can be produced at will. Other machines of less importance were also shown.

Terra cotta in its various forms was a striking feature of the Exposition, both in the Main and Government Buildings. Those in the latter have been generally mentioned. In the Main Building there were many splendid examples, both American and foreign. These cannot be described here in detail, but the exhibit of the Northwestern Terra Cotta Works, of Chicago, deserves at least mention. The display was very large and the work artistic. There were many beautiful figures and designs shown in which I was very much interested.

Terra cotta lumber is a new application of clay in the construction of buildings. A small annex, on the west side of the Government Building,

in the form of a Swiss cottage, contained the joint exhibit of the Gilman Porous Terra Cotta Company of New York City and the Minnesota Terra Cotta Lumber Company of St. Paul, Minnesota.

Terra cotta lumber is a fireproof material. It is made of gritless clay ground and mixed with sawdust, and in that condition prepared by machinery, like that above described, into convenient forms. When dry it is burned in kilns, the sawdust with the clay forming part of the fuel, and in consuming leaves the clay porous and light. It is called lumber because it can be worked with tools and can be nailed to rafters and scantling like common boards. In England it is called "wood-brick," and in Germany "holstein," or wood-stone. This material is made into many forms, as bricks, tiles, shingles, siding, and flooring. These can be laid in walls, or nailed on roofs or sides of houses like common lumber; and buildings so constructed are to a certain extent fireproof. Descriptive catalogues of this manufacture and the brickmaking machines mentioned above, have been placed in the library of the State Mining Bureau, where they may be referred to by those interested.

ERRATA.

Page 16, sixth line from foot of page, for "thrice," read twice.
Page 21, fifteenth line from top of page, for "citizens," read artisans.
Page 27, twenty-first line from foot of page, for "natural," read national.
Page 27, third line from top of page, for "which originally," read originally.
Page 27, tenth line from top of page, for "location," read construction.
Page 49, eleventh line from top of page, for "designated," read designed.
Page 60, nineteenth line from top of page, for "Agalmamolite," read Agalmatolite.
Page 61, second line from top of page, for "Chryotile," read Chrysotile.
Page 67, sixth line from top of page, for "mantlepiece," read mantelpiece.
Page 67, sixth line from foot of page, for "Chalcocite," read Chalcosite.
Page 68, third line from foot of page, for "Alph," read Alpha.
Page 72, twenty-third line from top of page, for "Spalerite," read Sphalerite.
Page 79, fifteenth line from foot of page, for "Sierra, Buttes," read Sierra Buttes.
Page 80, eleventh line from top of page, for "Cambrean," read Cambrian.
Page 80, seventeenth line from foot of page, for "trails," read trials.
Page 82, twenty-seventh line from foot of page, for "foreman," read foremen.
Page 84, eighteenth line from top of page, for "of testing," read and testing.
Page 86, sixth line from top of page, for "gold from," read gold which from.
Page 94, twenty-ninth line from top of page, for "Redwood City Mine," read Redwood City.
Page 95, sixteenth line from top of page, for "while some," read some.
Page 100, twenty-fifth line from top of page, for "Faulknau," read Falkenau."
Page 106, sixteenth line from top of page, for "and in the extraction," read in the extraction.
Page 106, thirty-second line from top of page, for "Sonoma," read Sonora.
Page 138, twelfth line from top of page, for "on such elevations," read of such elevations.
Page 150, twenty-fourth line from top of page, for "wonderous," read wondrous.
Page 162, thirtieth line from top of page, for "placed on," read placed in.
Page 169, sixth line from foot of page, for "purposly," read purposely.
Page 184, second line from top of page, for "was appreciated," read were appreciated.
Page 199, eighteenth line from foot of page, for "liguminous," read leguminous.
Page 201, sixth line from foot of page, for "lime," read limestone.
Page 209, fifth line from foot of page, for "imbolite," read embolite.
Page 219, seventeenth line from top of page, for "is placed," read are placed.
Page 223, first line from top of page, for "chlorodizing," read chloridizing.

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SKETCH MAP
OF
SAN DIEGO COUNTY
SHOWING THE POSITION OF
MINES AND MINERALS
REFERRED TO IN THE 6TH ANNUAL REPORT OF THE
STATE MINERALOGIST OF CALIFORNIA
FOR THE YEAR ENDING JUNE 1ST 1886
HENRY G. HANKS
STATE MINERALOGIST
REFERENCES
SAN BERNARDINO COUNTY
LOS ANGELES COUNTY
PACIFIC OCEAN
LOWER CALIFORNIA
ARIZONA
BOUNDARY LINE
COLORADO DESERT
COLORADO RIVER
SAN JACINTO RANGE
SAN BERNARDINO RANGE
DRY LAKE
NEW RIVER BASIN
S. P. R. R.
CARRIZO CREEK
1ST STANDARD
2ND STANDARD
3RD STANDARD
4TH STANDARD
SAN JACINTO
TEMECULA
PAUBA
SANTA ROSA
LAGUNA
SANTA MARGARITA
SAN ONOFRE
LAS FLORES
PALOMAR OR SMITHS MOUNTAIN
PAUMA
SAN JOSE DEL VALLE
VALLE DE SAN JOSE
SANTA ISABEL
CUYAMACA
EL CAJON
JAMACHA
OTAY
LA JOLLA
SOLEDAD
LIGHT HOUSE
DRY CREEK
INDIO
PALMA SECA
LOS TORES
MARTINEZ
WALKERS
LONE PALM
DOS PALMAS
FINKS SPRING
FLOWING WELL
TORTUGA
MAMMOTH TANK
MESQUIT
MUD VOLCANOS
SACKETTS WELLS
INDIAN WELLS
CARGA MUCHACHO
PILOT KNOB
FORT YUMA
Gila River
CHEM-E-HUEVIS MTS
RIVERSIDE MTS
BLACK POINT
LA PAZ
OLIVE CITY
EHRENBERG
SWALLOW NEST BEND
DEEP WATER BEND
LIGHTHOUSE ROCK
THREE POINT BEND
SLEEPER'S BEND
EUREKA MINES
BARRIE ISLAND
CASTLE DOME CITY
T TERTIARY
A ARCHEAN
P PERMO - CARBONIFEROUS
Q QUATERNARY
NOTE THE COLORING OF THIS MAP IS PROVISIONAL

CALIFORNIA STATE MINING BUREAU.

HENRY G. HANKS, STATE MINERALOGIST.

SIXTH ANNUAL REPORT

OF THE

STATE MINERALOGIST.

PART I.

FOR THE YEAR ENDING JUNE 1, 1886.

SACRAMENTO:
STATE OFFICE............J. J. AYERS, SUPT. STATE PRINTING.
1886.

To his Excellency George Stoneman, *Governor of California:*

Sir: I have the honor herewith to submit the sixth annual report of the State Mineralogist, and report of progress of the California State Mining Bureau, for the year ending June 1, 1886, prepared in accordance with the Act of Legislature, approved April 16, 1880.

Permit me to express my thanks to you and to other State officials for courtesies extended to me, and for the interest you have taken in the State Mining Bureau.

I have the honor, sir, to remain very respectfully,

HENRY G. HANKS,
State Mineralogist.

REPORT.

HISTORY OF THE STATE MINING BUREAU.

A very full history of the California State Mining Bureau, from its commencement in 1880 to the fifteenth of May, 1885, may be found in the five annual reports which precede this. The history includes a relation of the many difficulties met with in the establishment of the institution, which it will not be necessary to repeat here.

The Board of Trustees appointed by Governor Stoneman, in accordance with an Act of the Legislature (Assembly Bill No. 78, which passed the Assembly February 11, 1885, and the Senate March 5, 1885), organized April 18, 1885.

The following gentlemen constitute the Board: William Irelan, Jr., S. Heydenfeldt, Jr., J. Z. Davis, Walter E. Dean, and George Hearst. William Irelan, Jr., was elected Chairman, and S. Heydenfeldt, Jr., Secretary.

The Act providing for a Board of Trustees is published in full in the fifth annual report of this office.

Immediately on the return of the State Mineralogist from the New Orleans Exposition, preparation was made for removal to the fine fireproof building recently erected by the Society of California Pioneers. The building is situated on Fourth Street, near Market, on the property donated to that society by James Lick.

The removal, which was made during an unusually rainy season, was nevertheless finished without serious loss from breakage, and the entire time, up to the date of this report, has been employed in placing the museum in order.

The collection of seven thousand catalogued specimens, and many not yet entered, is arranged in cases, and classified into seven principal groups, as follows: Minerals, Ores, Rocks, Fossils, Shells, Ethnology, and Sundries. The whole should now be rearranged into geographical divisions. This, by my calculation, would require the entire time of an industrious man for one year, as I have planned to do it. From this may be inferred the estimate I place on the magnitude and importance of the State Museum at the present time.

While the exhibition of the State minerals at New Orleans was worth far more than the cost necessitated by twice packing and thrice removing the specimens, it set back the work of the Mining Bureau for six months. The removal to the new building, and arrangement of the museum, occupied three months more. The specimens are now all in place, and I am pleased to state that no serious loss, or material injury from breakage, or otherwise, has been sustained.

PRESENT CONDITION OF THE STATE MINING BUREAU.

The condition of the institution is most satisfactory. The State is now in possession of a very extensive museum, which has cost but a trifle compared with its actual value.

It would have been impossible to make so large and varied a collection, even if many times the money expended had been at the disposal of the State Mineralogist, were it not that prospectors were willing to send to the State Mining Bureau many fine and interesting specimens in return for information extended to them. The State is greatly indebted to Wells, Fargo & Co., and the several steamship companies, for free transportation. The museum is one of which the people should be proud.

Mr. Joseph Wasson, to whom the State of California owes a just debt of gratitude, gave the future of the State Mining Bureau much thought, and nobly made the foundation broad and ample. But the institution has grown more rapidly than even he expected, and while it is at the present time in a healthy and prosperous condition, its future should be made the subject of careful legislation.

The institution has been carried through many difficulties, and has been placed in a safe and suitable building, and the financial management transferred to a Board of Trustees, who will care for it in the future. There is money enough to keep it alive until the meeting of the next Legislature. The museum is still growing, and will continue to do so. It is to be hoped that the next Legislature will make sufficient provision for its support.

From the experience I have made during a period of six years while holding the office of State Mineralogist, it is my opinion that the State Museum should be entirely separated from the office of State Mineralogist, and all the responsibility of that department removed from him. He should be provided with the necessary assistants and money (which need not be a large sum). The money for the support of his office, which is really the most important branch of the State Mining Bureau, should be entirely under his control, and he should be allowed to manage his department according to his own judgment, without interference from the Board of Trustees, he bearing the responsibility.

DONATIONS.

Many valuable specimens have been presented to the museum during the past year, and I regret that, owing to reasons mentioned elsewhere, it has been impossible to present in this report a full list of the names of those who have thus enriched the State Museum by their generous donations. I take this occasion to acknowledge, generally, the receipt of many valuable gifts which have been placed in the museum cases when it has been possible to do so. Others will be arranged and catalogued in due time.

CORRESPONDENCE.

This department has grown in proportion to the advance of the institution, and to that extent that it is now fully the work of one individual during business hours to care for it properly. I am sorry to say that the numerous letters received by the State Mining Bureau have not always been answered as promptly as they should have been—addressed as they were to an important institution in one of the most important States of the American Union. I can only offer as an excuse the utter impossibility of doing better, for reasons too often repeated in the reports of this office. The State Mining Bureau numbers among its correspondents scientific societies, State and foreign governments, and noted individuals, besides many citizens of the Pacific Coast, wishing information as to the natural resources of California. When it has been possible to do so, all procurable information has been given. The reputation of California as a mineral-producing State

is so widespread, and so much is expected of the Mining Bureau and the State Mineralogist, that it is a matter of regret that his work has been impeded for want of needed assistance in this department.

CHEMICAL WORK.

Since Mr. Edward Booth, the very efficient chemist employed during the first year of the Mining Bureau, was discharged for want of funds, nearly all the chemical work has been done in the private laboratory of the State Mineralogist, maintained at his own expense. The work has been considerable, but not in proportion to the requirements of the office. Some of the results will appear elsewhere in this report.

LIBRARY.

Very few volumes have been added to the library. Since the administration of the Board of Trustees a few valuable works have been purchased and a few acquired by donation.

VISITORS.

The number of visitors to the museum has gradually increased. Since the removal to the new rooms the increase has been very noticeable.

PUBLICATIONS.

The reports of this office, although below my standard, are much in demand, showing the interest taken by the world in our affairs. These reports should be made fuller and better with each issue; but this cannot be done until the State Mineralogist is furnished with more assistance and money with which to visit the localities in the State where valuable minerals are found. No matter how industrious he may be in collecting and arranging matter for his publications, unless he has clerical assistance to carefully revise the work, annoying and discreditable errors will be found when it is too late to correct them in the too hastily prepared reports. For these reasons the publications are not without certain crudities. If the most valuable parts of each volume were carefully revised, provided with maps and engravings, reprinted in one, and published officially, a volume would be so produced which might be given a wide circulation, to the advantage of the State.

SACRAMENTO STATE COLLECTION OF MINERALS.

There is at the Capitol, in the State Library, in rooms wanted for books, a large and valuable collection of minerals, which was purchased many years ago by the State at an expenditure of a considerable sum of money. It is my opinion that this collection should be joined to the one now in the Pioneer Building in San Francisco, to which it would form a fine supplement. Repeated efforts have been made to effect this union, but always with opposition. Still it seems to be the proper thing to join them.

STATE MAPS.

Considerable work has been done and much data collected with a view to the publication of a preliminary geological map of the State, and a large

map in sections, on a scale of one centimeter to the mile, on which it was intended to mark the exact locality of all valuable minerals found in the State. It is to be hoped that this work will be continued. An appropriation of several thousand dollars would not be too much for this alone.

CATALOGUE.

A portion of the third volume of the museum catalogue has been printed, which brings the numbers up to seven thousand. When the entries number nine thousand this volume will be put into book form by the State Printer.

ORIGIN OF THE NAME CALIFORNIA.

In preparing a history of the geological surveys and explorations of California, I frequently met with the statement that the name of our State was derived from a Spanish romance, published first in 1521. This was ignored or contradicted by other authors. I became very much interested in this subject, and wrote to the Librarian of the British Museum, asking him if there was such a work in his library. In due time a reply came from G. K. Fortescue, the Librarian, informing me that there was, and that in Chapter 157 the name California appears. Mr. Fortescue kindly offered to have the chapter copied for me, which I accepted, and received the chapter in Spanish, which follows this. I then applied to Mr. Camilo Martin, Consul for Spain, who made for me a literal translation, in which he aimed to reproduce in English the quaint idiom of the original.

In his first letter, Mr. Fortescue gave me certain references, which led to my finding in the Proceedings of the American Antiquarian Society, April 30, 1862, a paper on this same subject, by Edward Everett Hale, in which he quotes a few lines from the romance.

As the commander of the expedition sent out by Cortez did not discover Lower California until 1534, and as the romance was so popular that it passed rapidly through a number of editions, it is reasonable to infer that the name California had its origin in the fertile brain of the author. Mr. Hale seems to have been the first to discover and publish these facts.

LAS SERGAS del muy esforzado Caballero Esplandian, hijo del excelente Rey Amadis de GAULA.—Madrid, 1521.

CAPITULO CLVII.

Del espantoso y no pensado socorro con que la reina Calafia en favor de los turcos al puerto de Constantinopla llegó.

Quiero agora que sepais una cosa la mas extraña que nunca por escriptura ni por memoria de gente en ningun caso hallar se pudo, por donde el dia siguiente fué la ciudad en punto de ser perdita, y cómo de alli donde le vino el peligro le vino la salud. Sabed que á la diestra mano de las Indias hubo una isla, llamada California, muy llegada á la parte del Paraiso Terrenal, la cual fué poblada de mujeres negras, sin que algun varon entre ellas hubiese, que casi como las amazonas era su estilo de vivir. Estras eran de valientes cuerpos y esforzados y ardientes corazones y de grandes fuerzas; la insula en si la mas fuerte de riscos y bravas peñas que en el mundo se hallaba; las sus armas eran todas de oro, y tambien las guarniciones de las bestias fieras, en que, después de las haber amansado, cabalgaban; que en toda la isla no habia otro metal alguno. Moraban en cuevas muy bien labradas; tenian navios muchos, en que salian á otras partes á hacer sus cabalgadas, y los hombres que prendian llevábanlos consigo, dándoles las muertes que adelante oiréis. Y algunas veces que teinan paces con sus contrarios, mezclábanse can toda seguranza unas con otros, y habian ayuntamientos carnales, de donde se seguia quedar muchas dellas preñadas, y si parian varon, luego era muerto. La causa dello, segun se sabia, era porque en sus pensamientos tenien firme de apocar los varones en tan pequeño número, que sin trabajo los pudiesen señorear, con todas sus tierras, y guardar aquellos que entendiesen que cumplia para que la generacion no pereciese.

En esta isla, California llamada, habia muchos grifos, por la grande aspereza de la tierra y por las infinitas salvajinas que en ella habitaban, los cuales en ninguna parte del mundo eran hallados: y en et tiempo que tenian hijos, iban estas mujeres con artificios para

los tomar, cubiertas todas de muy gruesos cueros, y traianlos à sus cuevas, y allí los criaban. Y siendo ya igualados, cebábanlos en aquellos hombres y en los niños que parian, tantas veces y con tales artes, que muy bien conocian à ellas, y no les hacian ningun mal. Cualquiera varon que en la isla entrase, luego por ellos era muerto y comido; y aunque hartos estuviesen, no dejaban por eso de los tomar y alzarlos arriba, volando por el aire, y cuando se enojaban de los traer, dejábanlos caer donde luego eran muertos. Pues al tiempo que aquellos grandes hombres de los paganos partieron con aquellas tan grandes flotas como la historia vos ha ya contado, reinaba en aquella isla California una reina muy grande de cuerpo, muy hermosa para entre ellas, en floreciente edad, deseosa en su pensamiento de acabar grandes cosas, valiente en esfuerzo y ardid de su bravo corazon, mas que otra ninguna de las que antes della aquel señorio mandaron. Y oyendo decir cómo toda la mayor parte del mundo se movia en aquel viaje contra los cristianos, no sabiendo ella que cosa era cristianos, ni teniendo noticia de otras tierras, sino aquellas que sus vecinas estaban, deseando ver el mundo y sus diversas generaciones, pensando que con la gran fortaleza suya y de las suyas, que de todo le que se ganase habria por fuerza ó por grado la mayor parte, habló con todas aquellas que en guerra diestras estaban, que seria bueno que, entrando en sus muy grandes flotas, siguiesen aquel viaje que aquellos grandes principes y altos hombres seguian; animándolas y esforzándolas, poniendoles delante las muy grandes honras y provechos que de tal camino seguirseles podrian, sobre todo con muy grande fama que por toda el mundo dellas seria sonada, que estando así en aquella isla, haciendo no otra cosa sino la que sus antecesores hicieron, no era sino estar como sepultadas en vida, como muertas viviendo, pasando sus dias sin fama, sin gloria, como los animales brutos hacien.

Tantas cosas les dijo aquella muy esforzada reina Calafia, que no solamente movió á sus gentes á consentir en el tal camino, mas ellas, con mayor deseo que sus famas por muchas partes divulgadas fuesen, le daban priesa que entrase en la mar luego, porque se hallesan en las afrentas, juntas con aquellos tan grandes hombres. La Reina, que la voluntad de las suyas vido, sin mas dilatar, mandó bastecer su grande flota de viandas y de armas todas de oro, y de todo lo demás necesario, y mandó reparar la mayor fusta de las suyas, hecha á manera de una red de gruesa madera, y hizo en ella meter hasta quinientos grifos, que, como ya se vos dijo, desde pequeños mandó criar y cebar en los hombres; y haciendo allí meter las bestias en que cabalgaban, que de diversas maneras eran, y todas las mas escogidas mujeres y mejor armadas que tenia en la flota, dejando tal recaudo en la isla con que segura quedase, y metióse ella las otras en la mar; y dióse tanta priesa, que llegó á las flotas de los paganos aquella noche que se os dijo del combate; con que todos ellos hubieron muy gran placer, y luego fué visitada de aquellos grandes señores, haciendole muy grande acatamiento. Ella quiso saber en qué estado estaba su hecho, rogándoles mucho que por extenso se lo contasen, y oida la relacion dello, dijo: "Vosotros habies combatido esta ciudad con vuestras grandes gentes, y no la pudístes tomar; pues yo con las mias, si á vosotros pluguiere, quiero el dia siguiente probar mis fuerzas á que bastarán, si quisieredes estar á mi consejo." Todos aquellos grandes señores le dijeron que como por ella fuese señalado, que asi lo mandarian cumplir.

"Pues enviad luego á todos los otros capitanes que por ninguna manera salgan mañana ellos ni los sujos de sus estancias, hasta que por mi les sea mandado, y veréis un combate el mas extraño que hasta hoy nunca vistes, ni de que jamás oistes hablar." Esto fué luego hecho saber al gran soldan de Liquia y al soldan de Halapa, que tenia cargo de todas las huestes que estaban en la tierra; los cuales así lo mandaron á todas sur gentes, maravillándose mucho á qué podria acudir el pensamiento y obra de aquella reina.

TRANSLATION.

The Exploits of the very valiant Knight Esplandian, son of the excellent King Amadis of Gaul.—[Madrid, 1521.]

Chapter CLVII.

The marvelous and not thought of succor with which the Queen Catafia came to the Port of Constantinople in favor of the Turks.

I wish you now to know a thing the most strange which ever either in writing or in people's memory could be found, by which the city was the following day on the point of being lost, and how from there where the danger came, salvation came to it. Know then that to the right hand of the Indies, there was an island called California, very near the part of the terrestrial Paradise, and which was inhabited by black women, without there being among them even one man, that their style of living was almost like that of the Amazons. They were of robust bodies and valiant and ardent hearts and of great strength; the island itself was the strongest that could be found in the world through its steep and wild rocks; their arms were all of gold and also the harness of the wild beasts on which they rode after taming them, as there was no other metal in the whole island; they dwelled in well-finished caves; they had many ships in which they went to other parts to obtain booty, and the men whom they made prisoners they took along, killing them in the way you shall hear further on. And sometimes, when they were at peace with their adversaries, they used to mingle with them with entire confidence; if any of them gave birth to a son, he was put to death at once. The reason for it, as it was known, was because in their thoughts they were resolved to lessen the men to so small a number that they would be able to master them without much trouble, with all their lands, and preserve those who would understand that it was convenient to do so that the race might not perish.

In this island, called California, there were a great many griffins, the like, on account of the ruggedness of the land and the very many wild beasts therein contained, were not found in any other part of the world; and when they had little ones, these women would go covered with thick skins to catch them by tricks, and they would bring them to their caves and there rear them; and when they were accustomed to them, they would feed them with those men and with the male children they bore, so often and with such cunning that they very well learned to know them, and never did them any harm. Any man who landed on the island was at once killed and eaten by them; and though they might be glutted, they would not the less take them and lift them up, flying through the air, and when tired of carrying them, they would let them fall, where they would be killed at once. Well, at the time when those great men of the pagans departed with those large fleets, as history has already told you, there reigned in said Island California a Queen very tall of stature, very handsome for one of them, of blooming age, desiring in her thoughts to do great deeds, valiant in spirit, and in cunning of her fearless heart, more so than any of the others that before her reigned in that seigniory. And having heard how the greatest part of the world was moving in that expedition against the Christians, she, not knowing what beings were the Christians, nor having any knowledge of other countries except those which were next to hers, wishing to see the world and its different races, thinking that with her great valor and that of her adherents all that would be gained she would have, by force or by cunning, the largest share of, she spoke with all those that were skillful in war, telling them that it would be well that, going in their great fleets, they should follow the same road that those great princes and eminent men were taking, inciting and encouraging them by laying before them the very great honor and gain that might result to them from that undertaking; above all, the great fame that would resound in the whole world about them; that remaining in the island as they were, doing nothing but what their ancestors had done, would be only to be buried in life, like living dead, passing their days without fame and without glory, like wild animals.

So many things said to them by that very valiant Queen Calafia, that she not only moved her people to consent to the undertaking, but they, with their great desire that their fame should be published in many parts, hurried her to put to sea at once, so as to happen to be in the danger jointly with those great men. The Queen, who saw the determination of her people, ordered her great fleet to be supplied with provisions, and with arms all of gold and with all other necessaries; and she ordered the repairing of her largest vessel, made like a grate of thick timbers, and she had put into her up to five hundred griffins, which, as you have been told, she had raised from tender age and fed with the flesh of men, and having therein also put the animals on which they rode, and which were of different kinds; also, the best chosen and best armed women which were in the fleet, and, leaving such garrison in the island as to be secure, she put to sea with the others, and she hurried so much that she joined the fleets of the pagans the night of the combat, of which you have been told, which caused them all very great pleasure, and then she was visited by those great lords, who showed her great reverence. She wanted to know in what state was their enterprise, begging them to relate it to her minutely; and having heard the report from them, she said: "You have fought this city with your many people and could not take it; well, I with mine, if it is agreeable to you, will, on the following day, try the reach of my power, if you will accept my advice." All those great lords answered her, that whatever was by her indicated, they would order it executed. "Then notify at once all the other commanders that to-morrow, on no account, they nor theirs leave their quarters, until it is so ordered by me, and you shall see a fight the most strange never seen before this day, and of which you never have heard spoken." This was then made known to the great Sultan of Liquia and the Sultan of Halapa, who had charge of all the armies which were on land, and who thus ordered their people, wondering much what could be the thought and deed of that Queen.

GENERAL CONDITION OF MINING IN CALIFORNIA.

California is just emerging from a condition of things that will be remembered for many years to come with regret and astonishment, and which will pass to history as one of those periodic manias which come over mankind like a calamity and shake the very foundations of society.

If the majority of the people of the Pacific Coast should be informed that instead of having been engaged in mining, they have simply been gambling, and have in the most foolish manner possible, given up their money to a comparatively few unscrupulous and dishonest sharpers, they would be slow to admit the fact, yet perhaps in the annals of history, there has never been such a wholesale transfer of money from a multitude of pockets to a few, without consideration, under the deceptive but fascinating name of mining.

Stock gambling is in no sense mining. It is a favorite excuse by those who have lost their savings in this way, to say sadly, "I invested all my

money in mines and lost it," which most of them did not, but bought worthless stocks instead. To recount the most successful deceptions that have been practiced to induce those who had money to invest it in stocks, would fill many pages and leave much more to be said. Still honest gold and silver mining presents the best field for the investment of capital of any business in California, for the following reasons:

Gold is becoming scarce, and consequently its purchasing power is greater than it has been for many years. The market for gold is in no way dependent on the population of the Pacific Coast; while a large population is essential to render manufacturing successful. We can produce gold with perfect confidence that the market of the world will gladly take all we are willing to spare, and in return will manufacture for us cheaper than we can hope or desire to do for ourselves.

Mines can now be worked in California at a much less cost than during the delirium of the first gold excitement, for the reason that transportation, provisions, labor, and fuel are cheaper; and every ounce of gold obtained is practically of double value. These facts are well known to intelligent miners in the State, and our mines are being better worked than ever before. New quartz veins are being taken up wherever they can be found; and there are indications of a new era in mining, which, it is to be hoped, will cause renewed prosperity in the State, even if we cannot utilize our vast deposits of placer gold.

MINING ECONOMIES.

Within a few years railroad lines have been extended and settlements advanced. Ores that could only be worked if they would yield from twenty-five to fifty dollars per ton are now found to be rich, as they can be mined and milled at a very reduced expense. Dump piles, formerly considered worthless, are now valued at many thousands of dollars. Tailings, allowed to go to waste in former years, are now being prospected and assayed. The concentration of these tailings will furnish employment for many men in the near future.

When on a large scale gold quartz has been crushed in quartz mills, a sandy powder passes through the screens and over the amalgamating copper plates. Theoretically the gold contained in the quartz remains attached to the mercury; what flows away (which is nearly all that passes the screens) is known among miners as tailings. If the operation of milling was as perfect in practice as in theory, the tailings would be worthless, but this is not the case; not only does a considerable quantity of gold escape, but mercury also. The sulphurets, which are nearly always auriferous, are not decomposed in the operation, and carry their precious contents with them to the beds of the streams below the mills, or to the reservoirs, which the most prudent of superintendents or managers provide for the reception of the tailings. The ordinary quartz mill saves only *free* gold, and even a portion of that escapes, owing to defective milling, and the sometimes peculiar condition of the gold, which has been before referred to in these reports. Mercury is used in the batteries, and on the plates, but, notwithstanding the skill acquired by the amalgamators, and the experience of many years in California, a considerable portion escapes, taking gold with it that had already become amalgamated. To prevent this well known loss many ingenious inventors have spent years of their lives and much money in the construction of machines and in the planning of processes, many of which have been patented, until the art of concentration has reached a point approaching perfection. But there is still

room for improvement. There is a great future in California for the concentration of tailings and low grade ores which were wasted during the time of excitement, when it was found to be more profitable to extract gold and silver from the pockets of the credulous than from the mines. In this connection it is interesting to note that companies are now engaged, with large capital, in working the lead slags of Laurium in Greece, and other ancient mines in Spain, and with great profit.

The following newspaper extracts have a special bearing on this subject:

In cleaning up in quartz mills a lot of scraps of iron are always found, consisting of fragments from shoes, dies, shovels, picks, hammers, and drills; and these lumps are knocked about in the mortar until numerous particles of gold are driven into their interstices. A lot of such scraps collected in the Jefferson Mill, in Yuba County, supposed to weigh half a ton, after being broken up with sledges, were digested in warm sulphuric acid until the surface had been eaten away and the gold liberated, and the yield thus obtained was $3,000. The shoes and dies, being too large to be broken up or digested in acid, were boiled half an hour in water, and then when the iron was repeatedly struck with a hammer, the particles of gold dropped out.

The Pennsylvania Company have run a lot of tailings, formerly considered worthless, through one of Wheeler & Randall's grinding pans, and cleaned up eighty-four ounces of amalgam, worth $5 per oz.

In some comments yesterday on the new drift of mining industries, the more extreme instances of the working of low grade ores were not cited. In Calaveras County during the last two years more than eighty thousand tons of quartz rock have been worked by one mill, the yield of which rock was less than two dollars a ton. And yet this mine was worked at a profit—the yield per ton ranging from one dollar and eighty cents up to about one dollar and ninety-five cents. The assays show that the rock carried more gold. But this is all that could be saved by any process now known. Of course, when the yield per ton is so small, there must be many advantages of working. The quartz must be abundant, and there must be no long land transportation. It would appear from these and other facts that low grade gold quartz can be worked with as much advantage now in California as in Australia, or in any other part of the world. These facts are of special importance just now, while fresh attention has been turned to gold quartz mining in California. Gold bearing ledges will not hereafter be neglected because of low grade ores. Nothing comes amiss now in that way from two-dollar ore in good situations up to twenty-dollar quartz in more remote and less accessible districts.

The value of the gold in the tailings not only of the quartz mines, but the hydraulic mines, is something enormous. It is considered by the most practical miners in California that at least one half the gold in placer mining is lost—or, rather, not saved. The loss of mercury may be reckoned by hundreds, if not thousands, of tons. This can to a great extent be recovered by reworking and concentration. This subject is well worthy the attention of laborers and capitalists.

IMPORTANCE OF GOLD AND GOLD MINING.

It cannot be denied that the love of gold is widespread, intense, and universal. It is vain to argue that gold is not an absolute necessity—to say that we cannot eat or wear it; that it is heavy and cumbersome—for we learn both in ancient and modern history that from the earliest ages mankind would sacrifice almost everything else for gold, and would even risk their lives to obtain it. The producers of all other staples, and the manufacturers of all articles of use and luxury, will gladly transport them from the ends of the earth and lay them at the feet of the miner in exchange for his yellow gold.

During a golden age, such as that through which we have just passed, real and personal property increase enormously. Without gold it would be impossible that there should be so many men possessing great wealth,

known as millionaires. The country that produces, holds, or utilizes the most gold, makes the greatest progress, and advances most rapidly in civilization and power. The discovery of gold in California stimulated commerce and manufactures and general progress more than any event in modern history, and its effect was felt over the whole civilized world. Without it the Pacific railroads would not so soon have been built, nor would the advancement of the Pacific Coast have been so rapid.

There has never perhaps been a period when labor has been so well paid and the world progressed as during the recent golden age, for in all former gold excitements the precious metal was extracted by slave or convict labor, and enriched kings instead of the people. While it is true that the thirst for gold brings in its train many evils, it must also be admitted that it is productive of much good. It begins to be realized by the world generally what a powerful lever or motor gold is to commerce, manufactures, and trade; that on the product of distant gold fields depends the rise and fall of prices, including salaries, in countries not producing gold, and whether trade and manufactures shall thrive or languish. In the United States the importance of our gold production is too often wholly disregarded, or but slightly considered.

Gold is true wealth. It cannot be destroyed by fire or by the action of ordinary chemical agents, and will always command its bullion value in whatever state or condition it may be. It is not only wealth in itself, but is the accepted measure of all other values. There is no other description of real property that can be so readily turned to account as gold. It seeks no market; on the contrary, all branches of trade and commerce seek it.

In digging for gold, the most desired of all products, natural or artificial, the miner becomes a consumer of all other products, and has at the same time the power to purchase them, conditions which render trade or barter most active. In the exchange of commodities—the business of the merchant—nothing is produced; the world is accommodated, but actual wealth is not increased. So with the manufacturer. He adds to the value of the crude material, but adds nothing to the actual wealth of the world. The agriculturist also produces what is consumed as food, and must be reproduced from the same source. But the real wealth of the world is derived from its crude products, generally dependent upon mining. The checking of gold mining, then, in our State, becomes a very serious matter, and affects not only California, but the United States and the world. Since it can be shown that our great and exceptional prosperity for many years was owing to the advantage we derived from our prolific gold fields, is it not more than possible that we have made a great mistake in crippling the most important producers, the gold miners?

The failure of any legitimate harvest is felt far beyond the area of its production. Thus the sudden cessation of the cotton crop in the Southern States, during the civil war, was the cause of great and widespread destitution among the mill operatives of Great Britain. In the same way the decrease of the gold crop of California not only places the people of our State at great disadvantage, but is felt in the general depression of business and the stringency of the money market in the country at large.

When the supply of gold diminishes suddenly, there follows a series of financial crises, so calamitous and far reaching that the most distant lands suffer in common with us. It can be shown that the present shrinkage in values, which is distressing the laboring classes at home and abroad, is the direct result of this decrease of gold, and is only a repetition of what has occurred many times in history under similar conditions.

If you ask ten men of average intelligence the cause of the present

general stringency of the times, the uneasiness of capital, the clashing between laborer and employer, the uprising of the many against the few, the stagnation of trade the world over, the apparent overproduction of manufactures and crude material, each would give a different answer, and probably none of them would be the full solution of the question. The primary and immediate cause is the scarcity of gold. Other minor influences are generally local, and nearly all of them hinge on the former.

The best thinkers and financiers of Europe assume that the production of gold is less than the requirements, and gold coinage is nearly suspended.

Assuming, therefore, the fall of prices to be caused by the diminished gold production, we must admit that if this were gradual, it would occasion no serious distress. It is the *sudden* diminution that causes the disturbance. Our people have the same elements of prosperity, but cannot divert the property they possess, or exchange to mutual advantage as when gold was plentiful. It is claimed that gold is hoarded in bank and Government treasuries. If this was so, the very necessity of the case would cause it to be brought out and used. The real truth is that it is scarce, and becoming more so, and unless new and prolific gold fields are discovered, the present depressed condition of trade will continue until prices adjust themselves to the increased value of gold.

Because the management of our gold and silver mines has too often been unwise and extravagant, and because in the days of our plenty we have disregarded small things, it should not be charged that the business itself is defective. On the contrary, its excellence is proved by its frequent success, even under admitted mismanagement.

Gold mining is a legitimate, honorable, and interesting occupation, and, when properly conducted, as safe as any that can be mentioned. The Government of Victoria, in Australia, already realizes how important to the Colonies and the mother country is the continued production of gold, and has enacted laws to assist the prospectors in discovering and working new gold fields; while California, with less wisdom and foresight, discourages mining. It should be the policy of our State, as of other countries, to turn her vast mineral resources to the best account. Instead of crippling the gold miner, he should be encouraged and afforded special facilities for his work. Instead of treating him as a public enemy, he should be regarded as a useful and important agent in maintaining the wealth of the country. Instead of stopping the work of those who injure without malice a small portion of the agricultural lands of the State, we should rather consider the vast importance of the gold yield, and seek some remedy or formulate some plan, whereby the miner may continue his work and the farmer at the same time be protected.

BIMETALISM.

While it cannot be denied that gold is the king of metals, and that all values are measured directly or indirectly by it, silver and other inferior metals should not be scorned. From present indications California will become a large silver-producing State. Having had a period of gold production, a new era of silver begins to dawn upon us. It is known that at various times in the world's history, after an unusual output of gold, when that metal became scarce some inferior metal was substituted for it. Silver was at first taken for this purpose, but copper, and even iron, were also used for money. To this extent bimetalism is admissible and possible, but any attempt to establish and to long maintain a fixed relative value between any two or more metals, must result in failure.

The idea of sustaining a double standard is an absurdity. The word

standard implies something having a fixed or permanent value. While any one substance may be accepted as the measure of the comparative value of many or all others, if a double standard was possible, it would be equally possible to have a quadruple or multiple standard. There must be one standard, or none.

Any act of Legislature to create and maintain a double standard would be no less ridiculous than the deed of Xerxes, who lashed the Hellespont because it destroyed his bridge, or of Cyrus, who punished the river Gyndes.

So difficult has been the settlement of this question in times past—for it is as old as history—that the Chinese were compelled to substitute copper for gold as a measure of values. The standard, whatever its substance may be, is *fixed* only in name, for it fluctuates in obedience to the universal law of supply and demand; but as a standard it remains stationary, while everything measured by it fluctuates in proportion. This was shown in the case of United States currency during and immediately following the civil war, when paper was created a legal tender and assumed to be a standard. This was a fallacy, for while gold was said to fluctuate, it was in fact the currency that did so. In California, where we had no currency, the price of gold remained as nearly the same as it could, compared with other articles of commerce, and there was no change in the value of gold in other countries.

If it should be thought wise to make silver the standard, values would adjust themselves, and with an increased circulating medium, trade and commerce would prosper or seem to prosper as before. There would be no gold in circulation; if we wanted that metal we should have to buy it as we do any other commodity. Unless other nations also accepted the silver standard, our silver coin would be at a discount in all countries which retained the gold standard.

The acceptance by the United States of a silver standard would be a benefit to our State, for it would stimulate silver mining and lead to the opening of many mines now idle, whatever effect it might eventually have on trade and commerce.

We have the satisfaction of knowing that there are in our State practically inexhaustible reserves of the precious metals, which we can draw upon if we desire. That our people should not fully avail themselves of these advantages seems incredible.

DIFFICULTIES ATTENDING MANUFACTURING IN CALIFORNIA.

Another reason for encouraging mining in California is the difficulty which manufacturers experience in disposing of their products, owing to competition with the East and Europe, and to the small population of the State and Pacific Coast. If the miners cease to be producers they must embark in some other business or leave the State. If the former, there is no avenue open but agriculture, manufactures, or commerce, all of which are already full, not to say overdone. If there is no gold produced for exchange with other centers, it will prove a check to enterprise on this coast. The sudden cessation of the former golden income to our merchants, manufacturers, mechanics, and farmers, cannot but be felt in every department of industry.

Upon agriculture alone the former prosperity of our State cannot at present be maintained. In course of time, when our population becomes larger, and prices have sunk to a level with those in older States; when we form habits of economy, frugality, and providence; when we discover new coal mines, or learn to utilize our petroleum, and all the various resources

of our State, the general prosperity will equal that of others; but now, without gold, we have no special advantage over our sister States, save in climate.

Population of California and the Pacific Coast, as compared with other centers:

California, in 1880	864,694
Oregon	174,768
Washington Territory	75,116
Nevada	62,266
Arizona	40,440
Total Pacific Coast	1,217,284

New York and neighboring cities:

New York	1,206,299
Brooklyn	566,663
Newark	136,508
Jersey City	120,722
Patterson	51,031
Hoboken	30,999
Elizabeth	28,229
Total	2,140,451

It will be seen by the above figures that New York and the cities in its vicinity contain nearly twice as many people as the entire Pacific Coast.

How would New York prosper if it depended solely on its own inhabitants for a market? How can California support large manufactories with so small a markét, and against the competition of eastern dealers, who have far greater advantages and facilities, and produce manufactured goods cheaper than we can?

BUILDING STONES AND BUILDING MATERIALS IN CALIFORNIA.

I have had occasion in all my reports to allude to the building materials already found and likely to be found, and the increasing use of them in the State. The subject is of such importance that I cannot refrain from again calling attention to it, to sum up recent discoveries made and to give general information, which I trust will be interesting and instructive to citizens of the State who have not the opportunity or the leisure to study the large number of reference works which treat on this subject.

HISTORY OF BUILDING IN ANCIENT AND MODERN TIMES, WITH SOME ACCOUNT OF THE MATERIALS USED IN CONSTRUCTION.

The question as to what shall replace the perishable structures now so generally built in the State, and especially in the city of San Francisco, is one that should engage the serious and immediate attention of our people.

To those who have not well considered this subject, the solution would seem to be simply the selection of some accessible stone and its immediate use in buildings, but such hasty action might prove an error.

In the history of the world very serious mistakes have been made in the selection of building stones, to the injury of individuals and communities.

There are certain conditions which render stones suitable and durable in one locality, but short-lived and nearly worthless in others.

This was strikingly illustrated in the selection of stone for the construction of the Parliament Houses in London.

In their native beds these stones had withstood climatic influences for centuries, and two fine buildings, Southwell Minster and York Minster, both of the same material, and both many years old, were still in a good state of preservation. But when the same stone was laid in the magnificent walls of the palace, in the smoky, acid, foggy atmosphere of London, decay early commenced, and a system of patching, painting, scraping, and cleaning was found necessary, which has been continued at intervals, to the disappointment and chagrin of the good people of the world's greatest city. The obelisk which stood for thirty centuries, more or less, in the dry atmosphere of Egypt, crumbled in a few years in New York. If it had been set up in Arizona, or on the Colorado Desert of California, and protected from wind-driven sands, its deeply sculptured hieroglyphics would, without much doubt, have remained legible for a thousand years more. The desirable qualities which characterize a really good building stone are: *First*, durability. *Second*, beauty. *Third*, ease with which it can be cut into suitable forms for use. And, *Fourth*, proximity to the cities where the stone is required.

The advantages of stone over other building material may be summed up as follows: beauty, durability, and safety from fire and ordinary earthquakes, the latter an important consideration in California, and one we may not ignore.

In the one item of insurance alone, should fireproof buildings replace those of wood, millions of dollars would be retained in the country, while the cost of the Fire Department system would be reduced to a minimum.

The construction of good buildings gives employment to mechanics and workingmen, who are thereby enabled to support their families, and to live in comfort. Another consideration which is often overlooked is loss of capital employed in the construction of perishable buildings which become worthless in a few years. The rocks most generally used as building material are: *granite*, *syenite*, *porphyry*, *diorite* or *greenstone*, *lavas*, including basalt and trachyte; *freestones* or *sandstones*, and *limestones*, including tufa, travertine, and dolomite, *slates*, *serpentines*, etc.; all these are found in California and most of them are abundant.

The crust of the earth, as far as known to man, is composed principally of seven minerals, to the extent of nineteen twentieths, as follows:

1. Quartz.
2. Talc or steatite.
3. Serpentine.
4. Hornblende and augite (varieties of pyroxene).
5. Feldspar, several varieties.
6. Mica.
7. Carbonate of lime.

When two or more minerals are mechanically mixed they form *rocks*, as generally understood. Some minerals occur in such large masses that they also are classified as rocks. The crystalline rocks as granite, syenite, gneiss, etc., are complex, and contain nearly, if not all the elements which enter into the composition of volcanic, plutonic, sedimentary, and metamorphic rocks, including the metals, gold, silver, lead, tin, iron, etc.

They decompose to sand, kaolin, and alkalies, which form new combinations in soils and minerals. Sandstones, shales, slates, mica schists,

and argillaceous rocks, are built up of the ruins of older crystalline rocks, and, if we are not mistaken, return to their former condition and become crystalline rocks again.

In California building stones abound. It was a wise remark made by some writer unknown to me, but frequently quoted, that "Time seldom spares what it does not take time to create." This aptly applies to the art of building, an art greatly conducive to the comfort, prosperity, and happiness of mankind.

Wood was extensively employed in building ancient cities. These temporary houses were replaced first by brick, and then by those constructed of marble and other building stones. Wood was largely used in Rome. Up to the time of Augustus brick was the common building material, but the upper part of the better class of dwelling houses still continued to be of wood. From the reign of Augustus better materials were generally introduced, and after the great fire in Nero's time, a volcanic rock now called "peperino" came into quite common use. Nero did not allow the wooden upper structures to be renewed, and made the streets wider and straighter. Peperino is a volcanic ash, cemented by carbonate of lime or silica. It is very light, and for that reason suitable for a certain class of buildings. It was extensively used in the ancient cities of Herculaneum and Pompeii. This rock, or one of a similar character, is abundant in California.

Specimens from ancient Rome may be seen in the State Museum, numbered 6437, and others.

During the splendor of the Empire magnificent and costly buildings, both public and private, were erected in Rome; each Emperor vieing with his predecessor in their construction. After the time of Augustus, the then known world was ransacked for new and elegant marble. It was early discovered that certain volcanic tufas or ash, called Pozzuolana, when mixed with the proper proportion of lime, became a hard and durable cement.

The discovery of the cementing properties of this material seems to have been accidental. At Baiæ, on the coast of Italy—which was a celebrated watering place and resort of the wealthy Romans in ancient times—it was thought desirable to increase the coolness of the situation by building the summer villas on masonry, extending beyond the shore, and surrounded by the waters of the bay. In experiments for this purpose, made with different cements or mortar, a kind of earth now known to be of volcanic origin, was discovered at Puteoli, to which the name of Pulvis Puteolanus was given, afterwards corrupted to Pozzuolana, by which it is still known.

It is claimed by historians, that to the discovery of this cement, Rome owes, in great measure, the massive and stately character of her public works and buildings, and that without it, the magnificent bridges, aqueducts, and roads, would ere this have fallen into decay.

California is known to be rich in volcanic materials, and it is not unlikely that Pozzuolana may yet be found among them. Such a discovery by the State Mining Bureau would be worth more to California than the whole cost of the institution since its inception. The fact that our State is specially subject to earthquakes, must be admitted. It is also known that it is possible to construct buildings that will resist all but the most violent shocks. Since the weakest part of modern buildings is the cement or mortar with which they are put together, it is evident we must improve the quality of that, in order to insure their durability. It has been observed in many old Roman structures, that the mortar outlasts the stones themselves, and that where the latter have been worn away by the

influence of time, the cement, in some cases, actually projects from their surface.

A tufaceous limestone or travertine of a pale straw color was found in extensive quarries near Tivoli, a few miles from Rome, which proved to be a durable and beautiful building stone. This became the principal building material of the ancient and modern city. It was selected by the Emperor Augustus, and soon a style of building which combined travertine with Carrara marble became very popular. The first great public building of this material was the Colosseum, which was finished by Vespasian and Titus. After it fell into ruin, it became a convenient quarry from which stones were selected to put into more modern buildings, and it is intimated that even Michael Angelo was guilty of this vandalism.

In more modern Rome the following well known buildings and many others of lesser note, are built of travertine: *St. Peter's*, the *Museum and Church of Lateran*, the *Castle of St. Angelo*, and the *Quirinal*.

Travertine had the convenient property of being soft when first taken from the quarry, and could be cut with a common saw, but it hardened with time. Specimens of pozzuolano and travertine also find a place in the State Museum. In ancient Greece marbles were also extensively used; in Egypt granite, syenite, and porphyry; in Babylon, sun-dried brick and asphaltum.

Many of the ruins of ancient cities show that architecture had reached a point, even in very ancient times, as near to perfection as anything human can. It is admitted that the moderns have never equaled the ancients, and at the present time our best architects are content to imitate them.

Marble is generally understood to be *carbonate of lime*, either white or colored, uniform or variegated, and pleasing to the eye; the term is also applied to any colored stone soft enough to easily cut, and hard enough to bear a good polish. Under the latter meaning may be classed the following minerals and rocks: dolomite, serpentine, verde antique, steatite, ophite, and even diorite, and porphyry; *Inyo marble*, so called, is dolomite.

Webster gives the following definition of marble: "Any species of calcareous stone or mineral of compact texture, and of a beautiful appearance, susceptible of a good polish; any firm limestone, fitted when polished or otherwise for ornamental use. Also other rocks of nearly the same hardness, capable of the same uses, as serpentine; but improperly, polished slabs of harder rocks, as porphyry, granite, and the like."

The name is derived from a Greek word, to *sparkle* or *flash*.

True marble is *carbonate of lime*, composed of carbonic acid and the oxide of calcium, or lime, in the following proportions:

Carbonic acid	44
Lime	56
	100

Edward Clarke, who traveled in Europe in the year 1800 and after, came to the conclusion, from his large experience and observation, that Parian marble was the most enduring of stones used in ancient sculpture and architecture; but Geike, the English geologist, informs us that inscriptions on marble tombstones, in large towns where coal smoke and rain are abundant, become illegible in fifty years. Crystalline limestone has been formed artificially by heating chalk or lithographic stone, which seems to prove that marbles are metamorphic. The accounts given by travelers and historians concerning the art works of the ancients, are almost incredible. Clarke describes in pleasing detail the architectural ruins met with by him in the Crimea, in Greece, and on the plain of Troy; Volney has written in the

most charming language of the ruins of Palmyra; and Pliny informs us that the art of cutting marble into slabs dates back to the building of the palace of Mausolus at Halicarnassus. The walls of that celebrated building, one of the seven wonders of the world, were of brick, covered with Cyzican marble from Proconnesus.

This art was introduced into Rome, and the described mode of cutting, by the use of strips of iron and sand, does not materially differ from that practiced at the present day.

The same author states that marble began to be used in public buildings in Rome in the Ædileship of M. Sacurus. His theater, described by Pliny as "the greatest that has ever been made by the hands of man," was three stories high. The lower was of marble, supported by three hundred and sixty columns of the same material; the second of glass, and the highest of gilded wood. This building was planned to seat eighty thousand spectators. After this period there was a rivalry as to who should erect the most costly and grand public buildings; interior walls were not only covered with the most costly imported marbles, but the stone was richly sculptured, and even in part painted or gilded. In the time of Nero, a method of inserting spots, or ornamental patches of other marbles, was invented—a sort of Mosaic or inlaid work, very costly and unnatural, but nevertheless much admired.

Then followed a general mania for marbles and rare ornamental stones, which were introduced into private as well as public buildings, and which were sought in every part of the known world.

The first private citizen who covered the entire walls of his house in Rome was Mamurra, who was only satisfied with the costly and rare marble of Carystus and Luna, the modern Carrara. M. Lepidus made the lintels of his house of Numidian marble (Giallo Antico), in the year of Rome 676. A few years later columns of foreign marble were first erected in Rome by L. Crassus, the orator; his house on the Palatine Hill was remarkable for its magnificence. The columns were six in number, and twelve feet in height; they were of Hymettian marble (Carrara).

L. Lucullus, when Consul, introduced into Rome a black marble, which was found on the island of Melos, and named Lucullan marble after him. We are indebted to Pliny for this information.

The following is a list of the rarer and most noted of ancient marbles:

White: Parian, Pentellic, Luna.
Black: Lucullan, Nero Antico.
Red: Rosso Antico, Cottonello.
Green: Verde Antico.
Variegated: Lumachella, Phrygian, Oriental Alabaster or Onyx.

The Parian and Pentellic marbles were pure white, and were considered better than those of Carrara. They are nearly pure carbonate of lime. Parian was found on the Island of Paros, one of the Grecian Archipelago. It could be distinguished by a peculiar luster on the freshly broken surface. The quarries from which this fine marble was obtained are very ancient. Pentellic marble was from Mount Pentellicus, in Attica, ten miles only from Athens. The Parthenon, in that ancient city, was constructed of this stone. Being completed in 438 B. C., it has resisted the destroying hand of time for two thousand three hundred and twenty-four years. Phidias, born four hundred and ninety years B. C., and Praxitales, celebrated Grecian sculptors, both worked on this, the most magnificent of ancient or modern buildings. The Pentellic quarries have been lately reopened.

Luna or Carrara marble is also nearly pure carbonate of lime (98.1 per cent), the usual impurities are clay, pyrites, and quartz. The marble often contains imbedded crystals of quartz, perfectly transparent and doubly terminated, called "Cararra diamonds." There are a number of varieties of this marble, but the best has a delicate waxy luster which is much admired: there are many fine specimens in the State Museum. The quarries of Carrara are supposed to have been opened by the Romans one hundred years B. C.: they were worked in the time of Julius Cæsar, and more extensively in the time of Augustus, who was called by Livy "the builder and restorer of all the temples." The ancient Etruscan seaport of Luna, eight miles from Carrara, described by Pliny as a "noble harbor," is now more than a mile and a half inland, with meadows extending to the shore. Marble was largely used in the construction of this city; large blocks still remain which are supposed to have been the seawall, from a large metal ring found attached to one of them. During the dark ages, Luna having then fallen into decay, was robbed of its marble blocks and columns, which were sent to construct buildings elsewhere. The marble for the Pantheon at Rome was brought from Carrara; this building was erected by Agrippa twenty-six years B. C., and is still in a good state of preservation. The palace and arch in the Via Domizi, and the baths of Caracalla are of Carrara marble. Lucullan black marble was supposed to have been brought from Meroe in Abyssinia; it sometimes showed small spots and veining of white, but the best quality was pure black. A California marble, recently found near Colfax, and numbered 2799 in the State Museum Catalogue, answers very nearly to the description of the Lucullan marble. The "Nero Antico" was also a black marble, said to have been found in Laconia; it was fine-grained and compact, sometimes showing delicate veining of white.

Fragments of "Rosso Antico" marble are frequently found in the ruins of ancient Rome. The locality of the quarry is unknown, but a similar, if not the same, marble has recently been found at Skautari, a village in Greece. It is of a deep blood red color, sometimes inclining to purple, and even rose color; and sometimes clouded with white, black, or purple lines. A fine specimen from ancient Rome may be seen in the State Museum, numbered 6020. This marble was much admired and prized by the ancients. A marble of beautiful rose color has been found in California; it is numbered 5344 in the Catalogue of the State Museum, and is nearly identical with "Rosso Antico." Very little is yet known of its occurrence, but it is likely to be valuable and important. A description has been given elsewhere.

Cottonello marble was found near a town of the same name a short distance north of Rome. It was of many shades of red, but of inferior quality, although somewhat extensively used.

"Verde Antico," or as it is now called in English, "Verde Antique," is not a true marble, but is serpentine combined with carbonate of lime or magnesia. It was much prized by the ancients, and is still extensively used. The color is due to oxide of chrome, and as chromic iron and serpentine are both common and abundant in California, there is reason to hope that this beautiful ornamental stone may yet be found in the State. There are many fine specimens of "Verde Antico" from Italy in the State Museum.

"Giallo Antico" was considered one of the most valuable and beautiful of the ancient marbles. The grain was very fine, and the coloring beautiful and rich. It resembled the Sienna and Verona marbles, but exceeded them in beauty and texture. It was first found in Numidia, in Northern Africa, and for that reason sometimes called "Numidian marble." It

received a high polish. The base or keynote color was yellow of many shades, from the deepest to nearly white or pale straw color. Some varieties were brecciated, and others veined or mottled.

There are a number of examples of this marble still to be seen in Rome; columns at the Pantheon, the Arch of Constantine, and two columns at the Vatican. An ancient quarry has lately been discovered in Algiers, which is supposed to be that worked by the Romans, and afterwards abandoned and lost.

A beautiful yellow brecciated marble has been found at Tehachapi in Kern County, California, which resembles some of the described varieties of "Giallo Antico." It is certainly very beautiful. It is numbered 710 in the State Museum Catalogue. Another mention of this beautiful marble is made elsewhere.

Sienna marble, found near Volterra, is from cream color to dark yellow, sometimes veined with white, and even black. It is much employed at the present time, and is a durable and beautiful ornamental stone.

Nummulitic, or Verona marble, is in color from cream to nearly white. It was much used in ancient and mediæval buildings; the Roman amphitheater of Diocletian was built of it. It was extensively used in Venice; the porch and interior columns of the cathedral of Verona are fine examples.

Lumachello, or "fire marble," owes its wonderful brilliancy and play of colors to imbedded shells; it is now found at Bleiberg in Carinthia.

The Phrygian marble was very rare and costly; the ground color was creamy white, with veins of dark red, sometimes pink, or yellow. From its fancied resemblance to the plumage of the peacock, it was sometimes called "Pavonazetta." The Emperor Hadrian was very fond of it, and it was used in the construction of his tomb. The temples of Juno and Jupiter had one hundred and twenty columns, and a pillar of it was found in the ruins of Pompeii.

Oriental alabaster or onyx marble was held in high esteem by the ancients a thousand years or more ago. The quarries were lost, and for a long time remained unknown, until rediscovered in Egypt in 1849, by M. Delmonte, a French traveler. The marble of the same nature found in California and known as "Suisun marble," and "California onyx," is more beautiful in some of its varieties than the ancient, and it has gained a world wide reputation for beauty. In the fourth annual report of this office, on folio 72, this beautiful ornamental stone has been described, and the principal locality given. Attention has only lately been called to the marbles of our State, and while few fine varieties are known, many more will doubtless be found. There is reason to believe that there will soon be an awakening in our State and principal cities to the importance of this subject, and in time our mountains, now so celebrated for the vast quantities of gold they have given to the world, will be searched over for building materials, and the fortunate person who discovers a quarry of good building stone or marble, will be more sure of a fortune than the gold seeker who now prospects the heights for the precious metals. In anticipation of this, new localities have been recorded in these reports, and discoveries already made. It will be seen that during the few years of the duration of the State Mining Bureau, that something has been accomplished in this direction.

TECHNICAL DESCRIPTION OF THE RED MARBLE (ROSEO ANTICO), FOUND IN AMADOR COUNTY, MENTIONED ABOVE.

Color, blood red, with mottlings of a slightly different shade, and an occasional vein of pure white. Specific gravity, 2.828; hardness, 3. By

qualitative analysis it was found to contain *lime*, *carbonic acid*, *oxide of iron*, and *silica*.

It dissolves with violent effervescence in hot hydrochloric acid, leaving a small red insoluble residue. The filtrate was golden yellow; ammonia threw down a heavy precipitate, leaving a transparent and colorless liquid, in which oxalate of ammonia caused a heavy precipitate of lime. This filtered off, phosphate of soda gave no precipitate, but the filtrate became slightly opalescent.

A few fragments of the marble, heated to redness in a platinum crucible, lost 14 per cent by weight. The residue was nearly white. It slaked and became hot on addition of water, but still contained carbonic acid, and effervesced slightly with hydrochloric acid. When dissolved and the residue dried on a water bath, a considerable portion was found to be magnetic. The non-magnetic portion looked, when seen under the microscope, like selenite, or more like brucite.

A sample treated in powder with cold diluted hydrochloric acid, left a large red residue, 9.4 per cent, and the solution was colorless. The red residue was partly soluble in boiling hydrochloric acid. Fused with alkaline carbonates it became decomposed, and was then soluble in hydrochloric acid, leaving a residue of silica, equal to 3.74 of the marble. The solution containing sesqui-chloride of iron was golden yellow; ammonia precipitated all the iron, leaving the solution colorless.

The yellow brecciated Tehachapi marble, from Kern County; the California giallo antico, mentioned above, was also examined chemically. It effervesced with acids and was nearly all soluble, the insoluble portion being only 1.6 per cent. From the solution carbonate of soda threw down a precipitate weighing 92 per cent.

Mr. Israel Luce, of Sacramento, called April 20, 1886, at the State Mining Bureau, and gave the following information regarding the locality of this marble.

The deposit is a large one, and is situated half a mile from the town of Tehachapi, on the road to Caliente. At that distance, on a flat on which there are springs of water, stands a small house. Less than a quarter of a mile from the house, up the hill, by an old wagon road, the excavations may be seen, and some large blocks lie quarried out. Mr. Luce says that some of the marble is of a pure yellow color and very beautiful.

TEHACHAPI MARBLE (not Giallo Antico).

Mr. W. G. Campbell called April 23, 1886, at the State Mining Bureau and informed me that the so called *Tehachapi marble* is found nine miles west of the town of Tehachapi, in Bright's Valley. It is found in large quantities, and there is a large block at the railroad station at Tehachapi. The marble is fine grained and beautifully mottled, resembling specimen No. 5860 of the museum catalogue.

The beautiful recently discovered Humboldt marble is found on the lumber claim of Flanegan & Brosman, seven miles from Eureka. This is all the information this office has concerning it.

DOLOMITE.

Dolomite is a double carbonate of lime and magnesia, sometimes in chemical equivalents, sometimes in mechanical mixture. It is called by many names, as dolomite, magnesian limestone, bitter spar, magnesian spar,

pearl spar, brown spar, compound spar, rhomb spar, muricalcite, picrite, tharandite, miemite, conite, gurhofian, and, lastly, Inyo marble.

It is considered true dolomite when in chemical proportions, otherwise magnesian limestone. Its hardness is from 3–5 to 4; specific gravity, 2–9; weight of cubic foot, about 180 pounds; luster, from vitreous to earthy; color, white, various shades of rose red, gray, brown, green, or nearly black. The composition is so varied that no single analysis would convey a correct idea; when expressed by the formula, Ca O, CO_2+MgO CO_2, it contains—

Carbonate of lime	54.35
Carbonate of magnesia	45.65
	100.00

In Klaproth's Chemical Mineralogy, published in English in 1801, may be found detailed analyses of two specimens, one from Sweden, and the other from the Tyrol, since which time very many analyses have been made and published. Before 1791 dolomite was confounded with the limestones, until the celebrated French chemist and mineralogist, Dolomieu, called attention to it. He first noticed it among the remains of ancient sculpture in Rome. In a paper to the Journal of Physics, he described it under the name of "A calcareous stone which effervesces but little with the acids." Saussure, a Swiss naturalist, found it in place in the Alps, and named it after the original discoverer "dolomie." The present name, "dolomite," was given to it in 1794 by Kirwan, an Irish chemist and mineralogist.

Dolomite was originally a sedimentary rock; this is proved by the fossils it often contains. There are several theories as to its formation, but the chemistry of its genesis is admitted to be very imperfectly understood. One theory is that it was formed in the beds of large lagoons, which became inland seas by being cut off from the ocean by some geological change in the earth's surface. As the confined water slowly evaporated, it dropped its lime, its salt, and lastly its magnesia, forming beds of dolomite. This theory is supported by the fact that beds of clay, gypsum, and rock salt are frequently found associated with dolomite. Another theory is that it was originally a precipitate let fall from the primitive sea by supersaturation, as thinolite is now being and has been formed in the alkaline lakes of the Great Basin of California, Nevada, and Utah. Still another theory assumes that the deposit was originally limestone, formed at the bottom of an ancient ocean, and that metamorphism has taken place by the addition of carbonate of magnesia from concentrated sea water, or by the abstraction of a portion of the lime by the action of water holding carbonic acid from a mineral or rock already containing a notable quantity of carbonate of magnesia. Dolomite has been formed artificially in several instances. Once in a glass flask containing a mineral water, which held bi-carbonate of lime and magnesia in considerable quantity, crystals of dolomite formed from two to three millimeters long.

Morlot produced dolomite crystals by heating carbonate of lime with solution of sulphate of magnesia in a closed tube.

Durocher subjected fragments of porous limestone in a bed of chloride of magnesium for three hours in a gun barrel kept at a red heat. Dolomite crystals formed which were stained yellow by iron. Other successful experiments of a similar nature have been recorded.

Dolomite has been used in sculpture, in architecture, and for making lime and cement. In the United States lime made of it is held in esteem,

but in England it is considered of bad quality, and is not much used. Magnesian limestones burn more easily, slake more slowly, and do not set so quickly as other limestones. As a building stone dolomite ranks among the best, but there are many different qualities, some of which are inferior to others. It is one of the chief building stones of the north of England, where a silicious dolomite is used in paving and building which gives perfect satisfaction. A yellow dolomite was used for the front of the Museum of Practical Geology in London, and the Parliament houses are built of it: but it has been shown that this stone was a failure. The commission of geologists and scientific men appointed to select a suitable stone for these buildings decided that crystalline dolomite was the best and most durable in proportion as the composition approached a mixture in chemical equivalents.

Dolomite was much used by ancient sculptors. The Apollo Belvidere, the greatest existing work of ancient art, is of dolomite. It was so called because placed in the belvidere of the Vatican. It represents the deity at the moment of his conquest of the python. The statue was found in the ruins of ancient Antium in 1503, and placed in the Vatican by Pope Julius II. Many other statues and works of art are of dolomite.

The so called Inyo marble has been selected for the building material to be used in the construction of the Sharon Gate at Golden Gate Park, and of which I am quite sure the people of San Francisco and California will be proud. It is my opinion that no use of the generous bequest could be more appropriate, or more likely to give general satisfaction, and I am fortunate in knowing by actual observation something concerning this now much-talked-of "Inyo marble."

As early as 1862 I traveled from the south side of Mono Lake to the head of Owen's Valley, then without a house or a settler north of Camp Independence. From Adobe Meadows our party of four saw for the first time the grand summit of White Mountain, capped with what seemed to be snow, slightly yellow in tint, which we attributed to the golden light of the setting sun, or dusty particles blown upon it from the desert adjacent: but snow it certainly appeared to be. When, however, we reached the base of the mountain, I discovered that the apparently snowy summit was in reality composed of a white rock: and in the rugged cañons we picked up fragments which, when freshly broken, were as pure and white as the finest Carrara marble. Subsequent chemical examination proved it to be dolomite of the finest quality. This was the now celebrated Inyo marble, which is found in numerous localities in the Inyo Range, from White Mountain south one hundred miles or more. While we make special mention here of Inyo marble, we must not for that reason omit to state that other beautiful marbles and building stones are found in those mountains, which I have seen and examined with great interest.

The most beautiful porphyries, equal to those of Egypt, are of frequent occurrence, while granite, syenite, pegmatite, and various crystalline and metamorphic rocks are met with in the sublime cañons, or lie tilted against the flanks of the higher mountains.

TECHNICAL DESCRIPTION OF INYO MARBLE.

Color, pure white, saccharoidal, cryptocrystalline, hardness between 3 and 4, scratches calc-spar with ease, specific gravity 2,856, which being the case a cubic foot will weigh 178.5 pounds avoirdupois. While in mass the mineral is resistant to crushing force, a small fragment can be crumbled between the fingers to a crystalline powder, which under the micro-

scope may be seen to be obscure crystals with concave faces; some four sided pyramidal terminations are more distinct. At a red heat continued for two hours, the mineral loses 30.3 per cent by weight; the calcined mineral when wet with water becomes very hot and falls to a powder. In cold concentrated hydrochloric acid the mineral even when pulverized effervesces but feebly, but on application of heat the action is intensified, and a perfect solution is obtained which is golden yellow when concentrated, and pale straw color when dilute. The hydrochloric acid solution becomes darker colored on addition of nitric acid, and solution of sulphocyanide of potassium imparts a deep blood red color to it. From the first solution ammonia throws down a small precipitate; the filtrate from this precipitate is colorless. Oxalate of ammonia throws down a copious precipitate; this being filtered off, phosphate of soda gives a second and also copious white precipitate. The mineral does not absorb water to any considerable extent; a fragment weighing 39.71 grains, soaked in water for twenty-four hours, increased in weight only 79 milligrams.

Before the blowpipe on charcoal the mineral falls to a powder like aragonite. This is owing to the fact revealed by the microscope that it consists of crystals distinct in themselves held together by a feeble force. In a closed glass tube the mineral gives traces only of water. These reactions show the presence of the following substances: Carbonic acid, lime, magnesia, iron, alumina. The two latter in small quantities, and traces of water. A full qualitive and quantitive analysis will be made in the future.

Measurements of the crystals, average of ten, in decimals of an inch:

Smallest	0— 00082 +
Largest	0— 02853 +
Average	0— 01472 +

Mr. Israel Luce, a marble cutter of Sacramento, has given the following information as to the quarry from which the Inyo marble is to be taken to build the Sharon gate to the park: It lies a few miles from Keeler and near the lake. The exact locality is the southwest quarter of section fourteen, township sixteen south, and range thirty-seven east. It is owned by the Inyo Marble Company, incorporated last September in the State of Nevada.

A variety of dolomite has been found cropping on the Contra Costa hills, not far from the State University. When found it was said to be pozzuolana. An analysis made by Professor Rising, of the State University, gave the following result:

Lime	24.52
Magnesia	17.48
Carbonic acid	38.48
Alumina and iron	3.13
Silica	14.55
Water	2.09
	100.25

The rock has not been sufficiently developed to prove its quantity.

THE FOLLOWING ARE LOCALITIES

Of the principal rocks, building stones, and building materials collected by the State Mining Bureau:

1. AGALMATOLITE (?), somewhat resembling the Chinese figure stone. This beautiful ornamental stone is found two miles west of Greenwood, El Dorado County, in a vein from six inches to a foot in thickness.
2. BASALT, plains between Oroville and Pence, Butte County.
3. BASALT. Used for street pavement. Mt. Pisgah quarries, one mile south of Petaluma, Sonoma County.
4. FINE GRAINED DIORITE OR BASALT, Folsom, Sacramento County. Strongly resembling serpentine externally.
5. BUILDING STONE, Mr. Wheat's house, Double Springs, Calaveras County.
6. DIORITE, wall rock of the Clipper Gap Iron Mine, Placer County.
7. DIORITE, near the bridge, section fifteen, township eighteen north, range thirteen east, Mount Diablo meridian, Placer County.
8. DIORITE, township thirteen north, range eight east, Mount Diablo meridian, Placer County.
9. DIORITE, iron mines near Clipper Gap, section twenty-four, township thirteen north, range eight east, Placer County.
10. DIORITE, wall of furnace building, Clipper Gap Iron Mines, Placer County.
11. DIORITE, fine grained, Mineral Hill District, Mono County. It contains considerable finely divided magnetite.
12. DIORITE, fine grained, in which magnetite is replaced by pyrites, Mineral Hill, Mono County.
13. DIORITE, croppings near Cave City, Calaveras County.
14. DOLERITE, east wall, Comanche Mine, Mono County.
15. DOLOMITE, Modoc Mine, Inyo County.
16. DOLOMITE, Guadalupe Quicksilver Mine, Santa Clara County.
17. DOLOMITE (resembling fossil coral), Morro, San Luis Obispo County.
18. DOLOMITE. Deep Spring Valley, Inyo County.
19. DOLOMITE, white, Amargosa Wash, San Bernardino County.
20. DOLOMITE, Inyo County.
21. DOLOMITE, white, Tujunga Cañon, seven miles from San Fernando, San Gabriel Mountains, Los Angeles County; valuable for building and manufacturing purposes.
22. DOLOMITE (impure), found near the State University, Berkeley, Contra Costa County; mistaken for pozzuolana.
23. FOSSILIFEROUS ROCK, near Soledad, San Diego County.
24. GARNET ROCK, Calpella, Mendocino County. A large cropping.
25. GLAUCOPHANE ROCK, wall rock of the Collier Mine, six miles northeast from Murphy's, Calaveras County.
26. GNEISS, brought to San Francisco on river schooners and used for street pavements.
27. GNEISS, said to be found in San Francisco in place.
28. COARSE GRANITE, near Sacramento.
29. GRANITE, Newcastle, Placer County.
30. GRANITE, Folsom, Sacramento County.
31. GRANITE, Rocklin, Placer County.
32. GRANITE, Yosemite Valley, Mariposa County.
33. GRANITE, Mariposa Mine, Mariposa County.

34. GRANITE, Crystal Lake, Summit Valley, Nevada County.
35. GRANITE (micaceous), near Penryn, Placer County.
36. GRAVEL, San Pablo, Contra Costa County.
37. GRAVEL, distinct from the sandstone; used in macadamizing streets, Los Angeles.
38. HORNBLENDE ROCK, Santa Barbara Mountains.
39. HORNBLENDE ROCK, Healdsburg, Sonoma County.
40. HORNBLENDE ROCK, Folsom, Sacramento County.
41. HORNBLENDE ROCK, Gold Run, Placer County.
42. LAVA, Mendocino County.
43. LAVA, Napa County.
44. LAVA, compact, near St. Helena, Napa County.
45. LAVA, basaltic, near Calistoga, Napa County.
46. LAVA, red, Butte Mountain, near Jackson, Amador County.
47. LAVA, near Santa Rosa, Sonoma County.
48. LAVA, trachytic (?), which caps isolated hills between Milton and San Andreas, Calaveras County.
49. LAVA, brecciated, found in immense cliffs, Little Shasta River, Shasta County.
50. LAVA, basaltic, showing a scale, which is due to oxidation of iron to limonite, near Doon's Mill, Butte County.
51. LAVA, white (so called), indurated volcanic ash, near Murphy's, Calaveras County.
52. LAVA, which exists in immense quantities on the borders of Mono Lake, Mono County. Owens River cuts through this formation in a deep cañon. It is easily decomposed, and supposed to yield the soda salts so abundant in that region. It crops out also at Adobe Meadows, in Mono County.
53. LAVA, white (so called), probably indurated volcanic ash, Southern Pacific Railroad, Los Angeles County.
54. LAVA, and pumice, Alviso, Santa Clara County. The Guadalupe River winds through a chain of volcanic vents. They rise but a few feet above the valley.
55. LAVA, cellular, with zeolite, Soledad Cañon, Los Angeles County.
56. LAVA, cellular, Captain Jack's Cave, Modoc Lava Beds, Modoc County.
57. LIMESTONE, calcite, Santa Cruz.
58. LIMESTONE, San Bernardino County.
59. LIMESTONE, tufaceous (thinolite?), Lassen County, section thirty, township thirty north, range fourteen west.
60. LIMESTONE (marble), Clipper Gap Lime Quarry, section thirty, township thirteen north, range nine east, Mount Diablo meridian, Placer County.
61. LIMESTONE (marble), Cave Valley, near Auburn, Placer County.
62. LIMESTONE (hydraulic?), found at the residence of Captain J. M. McDonald, San Francisco.
63. LIMESTONE (fossiliferous), Almaden Consolidated Quicksilver Mining Company, southwest quarter section thirty-four, township twenty-six south, range ten east, San Luis Obispo County; elevation fifteen hundred feet.
64. LIMESTONE, Bridgeport, Mono County.
65. LIMESTONE, Tres Pinos, San Benito County, fifteen miles east of the town.
66. LIMESTONE, Modoc Mine, Inyo County.

67. LIMESTONE, arenaceous, found in the bed of the river, near Yreka, Siskiyou County.

68. LIMESTONE OR MARBLE, blue, with veins of white, Pence, Butte County. It is soluble in hydrochloric acid with effervescence, leaving a small hepatic residue—when struck with a hammer it emits a feted odor—anthraconite—burns to a pure white lime, which slakes perfectly. This stone is well adapted for building purposes, as a useful and ornamental stone. Valuable, also, for manufacturing purposes.

69. LIMESTONE, Posa Creek, foothills of the Sierra Nevada, Kern County.

70. LIMESTONE, near Auburn, Placer County.

71. LIMESTONE, silicious, with what seems to be graphite or molybdenite in small scales, Kern County.

72. LIMESTONE (marble), Bitterwater Ranch, San Benito County.

73. LITHOGRAPHIC STONE, Kern County.

74. MAGNESITE (carbonate of magnesia), Tulare County.

75. MAGNESITE, Damascus, Placer County. Large quantities of this mineral at the locality.

76. MARBLE, white, fifteen miles from Monterey.

77. MARBLE, near Angel's Camp, Calaveras County.

78. MARBLE, Bear Creek, three miles from Colfax, Nevada County.

79. MARBLE, Abby's Ferry, Tuolumne County.

80. MARBLE, Giallo Antico, Tehachapi, Kern County.

81. MARBLE, white, Tuolumne County.

82. MARBLE, white, section fifteen, township thirteen north, range eight east, Mount Diablo meridian, Placer County. This marble has been used in San Francisco for the generation of carbonic acid in the manufacture of mineral waters. It is used also as a flux in iron smelting.

83. MARBLE, white, Tehachapi, Kern County.

84. MARBLE, black, near Central Pacific Railroad, two miles above Colfax, at the lower end of the high trestle, Placer County.

85. MARBLE, half a mile from the railroad depot, Auburn, Placer County.

86. MARBLE, from the Cave, at Cave City, Calaveras County.

87. MARBLE, bed of the Tuolumne River, Tuolumne County.

88. MARBLE, white, nine miles north of Ione, Amador County.

89. MARBLE, red, a beautiful ornamental stone, bearing a good polish, Amador County.

90. MARBLE, fine white, slightly bluish green, suitable for building stone and lime, Inyo County, near C. & C. R. R.

91. METAMORPHIC SLATE, which accompanies the quartz vein, Soulsby Mine, Tuolumne County.

92. METAMORPHIC SLATE, with quartz attached, Soulsby Mine, Tuolumne County.

93. MICA SCHIST, Gold Lake, Plumas County.

94. MICA SCHIST, Ivawatt District, San Bernardino County.

95. MICA SCHIST, Berkeley Hills, Alameda County.

96. PORPHYRY, foot wall Standard Mine, Bodie District, Mono County.

97. PORPHYRY, Bodie Mine, Bodie Mining District, Mono County.

98. PORPHYRITIC DIORITE, Clipper Gap, Placer County.

99. PORPHYRY, red, eight or nine miles from Mesquite Station, San Diego County.

100. PORPHYRY BEDROCK, Malakoff Mine, North Bloomfield, Nevado County.

101. PORPHYRY, Polar Star Mine, Dutch Flat, Placer County.

102. PORPHYRY (probably diorite), Placer County. Said to be found in large quantities. A very beautiful building and ornamental stone, equal to the finest porphyries of Egypt and Europe.
103. PORPHYRY, seventy-five feet thick, Bodie Mine, Mono County.
104. PUMICE STONE, near Mammoth City, Mono County.
105. PUMICE STONE, near Dos Palmos, San Diego County.
106. ROCK RESEMBLING HALLEFLINTA, Fruit Vale, Alameda County.
107. ROCK RESEMBLING HALLEFLINTA, Spanish Ranch, Plumas County.
108. SAND ROCK, with chalcedony, ten miles west of Havilah, Kern County.
109. SANDSTONE, near San José, Santa Clara County.
110. SANDSTONE, eighteen feet thick, Tuolumne County.
111. SANDSTONE, Saucelito, Marin County.
112. SANDSTONE, Glenn Mills, San Mateo County.
113. SANDSTONE, eight miles west of Napa City, Napa County.
114. SANDSTONE, suitable for building stone, Eureka, Humboldt County.
115. SANDSTONE (stained red), Santa Margarita Ranch, San Diego County, near San Luis Rey.
116. SANDSTONE, Glenn Mills, San Mateo County.
117. SANDSTONE, west side of Great Eastern Quicksilver Mine, Sonoma County, supposed to be the footwall.
118. SANDSTONE (coarse grained), Coal Mine, San Benito County, township nineteen south, range eleven east.
119. SANDSTONE (fine grained), Coal Mine, San Benito County, township nineteen south, range eleven east.
120. SANDSTONE, Seal Rock, off Point St. George, northwest boundary of California.
121. SANDSTONE, fossiliferous, near Shasta.
122. SANDSTONE, variegated, near Buchanan Copper Mine, Fresno County.
123. SANDSTONE, feldspathic, sedimentary rock, composed of feldspar, quartz mica, and hornblende, Telegraph Hill, San Francisco.
124. SANDSTONE, Pescadero, San Mateo County.
125. SCORIA, Point San Pedro, San Mateo County, eighteen miles south of San Francisco.
126. SCHIST with garnets, mouth of Russian River, Sonoma County.
127. SCHIST, with impressions of fossil plants, found in the lignite near Vacaville, Solano County.
128. SEDIMENTARY DEPOSIT, Chalk Bluffs, near surface, containing impressions of fossil leaves.
129. SEDIMENTARY MATTER, North Bloomfield Mine, Nevada County.
130. SEDIMENTARY DEPOSIT, found in digging a well, at a depth of seventy-five feet, near Roseville Station, Placer County.
131. SEDIMENTARY ROCK, San Francisco.
132. SEDIMENTARY ROCK, Cliff House, San Francisco.
133. SEDIMENTARY ROCK, Oil Creek, San Luis Obispo County, found in slabs from two to eight inches thick, and from one to three feet wide.
134. SEDIMENTARY DEPOSIT, resembling diatomaceous earth, twelve miles east of Santa Rosa, Sonoma County.
135. SERPENTINE, Bear Valley, Mariposa County.

136. SERPENTINE, Key's Tunnel, California Mine, Yolo County.
137. SERPENTINE, three hundred yards northeast of Pine Tree Mine, Bear Valley, Mariposa County.
138. SERPENTINE, transformation from gabbro, Peninsula of San Francisco.
139. SERPENTINE, Fort Point, San Francisco.
140. SERPENTINE, Yuba County.
141. SERPENTINE, Market and Guerrero Streets, San Francisco.
142. SERPENTINE, center of Lone Mountain Cemetery, San Francisco.
143. SERPENTINE (five varieties), Lone Mountain Cemetery, San Francisco.
144. SERPENTINE, Market Street Cut, San Francisco.
145. SERPENTINE SCHISTOSE, met with before reaching the so called footwall, New Almaden Quicksilver Mine, Santa Clara County.
146. SERPENTINE, Kelseyville, Lake County.
147. SERPENTINE, Bald Prairie, Placer County.
148. SERPENTINE, Monterey, Monterey County.
149. SHALE (with Lignite), near San Bernardino, San Bernardino County.
150. SHELL ROCK, Sandstone Bluff, township one north, and on the Humboldt meridian, Humboldt County.
151. SILICIOUS BRECCIA, Little Butte, section thirteen, township thirteen south, range thirty-five east, Mount Diablo meridian.
152. SLATE AND GRANITE, Bodie District, Mono County.
153. SLATE AND PYRITES, Mariposa Tunnel, two thousand six hundred and twenty foot point, Mariposa County.
154. SLATE, which crops out over a large extent of country between San Andreas and Cave City, Calaveras County; strike nearly west northwest, dip nearly vertical.
155. SLATE, near Red Hill, Butte County.
156. SLATE, near Emigrant Gap, Placer County.
157. SLATE, roofing, El Dorado County.
158. STRATIFIED FORMATION, old lime kiln, near Clipper Gap, Placer County.
159. SYENITE, Point San Pedro, San Mateo County, eighteen miles south of San Francisco.
160. TALCOSE ROCK, wall rock of the Idaho Mine, Grass Valley, Nevada County.
161. TALCOSE SLATE, Tuolumne County.
162. TALCOSE SLATE, El Dorado County.
163. TRACHYTE, near St. Helena, Napa County.
164. TRIPOLITE, Santa Barbara.
165. TUFA, Kern County.
166. TUFA, Sulphur Springs, Mono County.
167. TUFA, very interesting formation, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
168. VOLCANIC BRECCIA, used as a building stone in Susanville. It is said to resist the action of fire, as shown during a recent conflagration in that town. Section five, township twenty-nine north, range thirteen east, eight and one half miles from Susanville, Lassen County.
169. VOLCANIC CONGLOMERATE, Mono Lake, Mono County.
170. VOLCANIC ROCK, Kelsey Valley, Lake County, taken from a well ten feet deep. It is several feet in thickness. Sinking the well was discontinued, owing to the emanation of large quantities of carbonic acid gas.

171. VOLCANIC ASH (allied to pumice stone), Calaveras County, eighteen miles from Lodi.

172. VOLCANIC TUFA (so called white lava). A similar rock is used in Europe in building ovens for bread baking. Found near Etna Springs, Napa County.

173. VOLCANIC ASH, Chalk Bluffs, Nevada County.

174. VOLCANIC ASH, Ione Valley, Amador County.

175. VOLCANIC ASH, Tufa or Lava, Mono County, near Carson and Colorado Railroad.

The following have been added since the publication of the second volume of the museum catalogue:

176. ANTHRACONITE, cave at Murphy's, Calaveras County.

177. BITUMINOUS SHALE, from which oil and gas can be manufactured, Calistoga, Napa County.

178. BRECCIATED QUARTZ, vein matter, Calistoga or Venus Mine, Mt. St. Helena, Napa County.

179. BROWN COAL (Lignite), from vein near Lancha Plana, Calaveras County.

180. BUILDING STONE, Valley Springs, Calaveras County.

181. CAPROCK, used for paving sluices, worn from thickness of eighteen inches by eight months' use, Spring Valley Mine, Cherokee, Butte County.

182. CONCRETION, resembling a geode, Bottle Hill, El Dorado County.

183. DUNNITE, from Carga Muchacho gold mining district, San Diego County. This rock is more minutely described elsewhere.

184. FELDSPAR (orthoclase), Hunsecker Grade, stage road from San Diego to Julian, San Diego County.

185. FREESTONE, from Stony Brook, near Niles, Alameda County, on the property of J. D. Farwell. It seems to possess many of the qualities which characterize a good building stone. In the quarry where the croppings have long been exposed to the elements, it shows evidences of great durability, as it does laid in the piers and abutments of the railroad bridge which crosses the Alameda Creek near by. This block has been sculptured by Morton A. Edwards, of San Francisco, and was presented by J. D. Farwell.

186. LAVA, used in building at Mokelumne Hill, Calaveras County. Three varieties. It is a durable and convenient material, and could be more generally utilized.

187. PEGMATITE, Hunsecker Grade, stage road from San Diego to Julian, San Diego County.

188. ROCK SPECIMEN, from the summit of Mt. St. Helena, altitude 4,343 feet. It rises in columns like basalt, in large outcrops; the whole summit of the mountain is of this formation. The soil produced by its disintegration is of a pale green color. Napa County.

189. ROCK SPECIMEN, from the side of Mt. St. Helena, Napa County.

190. ROCK RESEMBLING HALLEFLINTA, found on the sides of Mt. St. Helena, Napa County.

191. ROCK SPECIMEN, with veins of cinnabar, Manhattan Mine, Napa County.

192. ROCK SPECIMEN, near Deffebach's Ranch, one mile from the bay, Sausalito, Marin County.

193. ROCK SPECIMEN, from first tunnel on N. P. C. R. R., Blithdale Station, Marin County.

194. ROCK SPECIMEN, with microscopical section, Union Mine, near San Andreas, Calaveras County, believed to be slaty serpentine.

195. ROCK CONTAINING FOSSIL TURRITELLA. Section thirty-three, township twenty-two south, range sixteen east, Mt. Diablo meridian. Fossils are very abundant at this locality.

196. SAND, from the beach, near the whaling station, Monterey, Monterey County.

197. SAND, from opposite the bath house, Santa Barbara.

198. SAND, from the ocean beach, two miles south of Pescadero, San Mateo County.

199. SERPENTINE, Point Tiburon, Marin County.

200. SERPENTINE FOLIATED, altered to Picrolite, found in considerable quantity in Mendocino County, township nineteen north, range ten west, Mt. Diablo meridian.

201. SILICIOUS MINERAL, OR ROCK, probably a deposition from hot mineral water. This specimen is opaque, and shows the effect of solfataric action about the orifices, round the mouths of which little ridges of silica have been deposited. Manhattan Quicksilver Mine, Napa County.

202. STEATITE, Coulterville, Mariposa County. Of excellent quality, and said to be in large quantities.

203. WALL ROCK, Manhattan Mine, Napa County.

204. WALL ROCK WITH FOSSILS, Manzanita Gold Mine, Sulphur Creek, Colusa County.

An excellent building stone is found in a white rock, of sedimentary origin, thought to be volcanic ash. It is found in the foothills over a large extent of country. It has been used in building in Mokelumne Hill, Calaveras County, for many years, where it has been found to be very durable. The walls of some buildings which were destroyed by fire are uninjured, or only slightly so. There are some fine buildings being constructed of this stone in St. Helena, in Napa County. Their general appearance is very fine. This material should be introduced into San Francisco and other large towns.

Basaltic rocks are quite common in numerous localities in the State. In Butte County, between Oroville and Magalia, there are large outcrops of cellular lava and fine columnar bluffs. The stone is of excellent quality, and quite suitable for pavements and building. The basaltic columns of Mount St. Helena have been described elsewhere.

EXAMINATION OF DUNNITE FROM SAN DIEGO COUNTY—NO. 183 OF THE ABOVE LIST.

Color pale green, with dark spots. It consists of three distinct minerals—*olivine*, *magnetite*, and a *micaceous mineral*, unknown.

In its natural state it slightly deflects the needle. When pulverized, a portion can be removed by the magnet, and on heating to redness, a second smaller portion becomes magnetic, and can be separated in the same way. A sample of rock was pulverized, sized by sifting, and placed in a long glass tube full of water. On placing the tube in a vertical position, the magnetite fell first. The other two minerals did not separate, but fell together, showing that they had nearly the same specific gravity.

Another portion was divided into three parts by the magnet as follows:

(A) magnetic	12.2
(B) magnetic by heating	2.1
(C) non-magnetic	85.7
	100.0

The non-magnetic portion (C) was examined under the microscope and found to consist of two minerals, one dark colored, but which changed to bronze color by heating. The other was pale green in nearly transparent angular particles, with vitreous luster. Being of the same sized particles, of nearly the same specific gravity, they were counted under the microscope and found to be in equal numbers very nearly, therefore the mechanical analysis would stand thus:

Magnetic (A)	12.20
Magnetic by heating (B)	2.10
Micaceous (D)	42.85
Pale green (E)	42.85
	100.00

The portion (C) from which magnetite had been removed by the magnet was boiled repeatedly in nitro-hydrochloric acid, by which treatment the micaceous mineral was decomposed. The residue being well washed, the pale green mineral (olivine) was left in a state of apparent purity. The specific gravity was found to be 3.321.

This is a beautiful and interesting rock, and one that it would seem might be put to some practical use. Sections cut for the microscope are also very interesting.

The following is the result of an examination of the straw-colored sandstone from Santa Barbara, used in the construction of the old Mission, and latterly in a number of fine modern buildings in the beautiful town of Santa Barbara: Specific gravity, 2.7; one part of the stone by weight absorbed only .012 parts of water. The stone is rather easily reduced to powder; more so when wet. In this respect it resembles the sandstone of a similar color found at San José. Under the microscope the powder is seen to consist of rounded grains of milky quartz. The silica was determined and found to be 75 per cent. The specific gravity being as above, a cubic foot would weigh 168.75 pounds. While this is a beautiful and easily worked building stone, its use in the old Mission has shown that it is not very durable.

TABLE OF ALTITUDES.

The first 1,109 are copied from Bulletin of the United States Geological Survey No. 5; the remainder are gathered from various sources, and may be considered as approximative. They are probably as correct as those generally first published in a new and large State like California.

No.	Station.	Authority.	Elevation. Feet.
1	Abbey Hill	U. S. C. & G. S.	1,232
2	Abbott	U. S. C. & G. S.	375
3	Acampo		59
4	Adalante	Cal. P. R. R.	76
5	Adams, Mt.	Wheeler	8,431
6	Adobe	Wheeler	282
7	Adobe Meadows	Wheeler	6,594
8	Agua Caliente	Emory	3,013
9	Agua Caliente	Wheeler	725
10	Agua Caliente	Wheeler	3,617
11	Alamo Mocho	P. R. R. Reports	—70
12	Alcatraz Island	U. S. C. & G. S.	143
13	Algodones	P. R. R. Reports	46
14	Alpine	C. P. R. R.	2,822

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
15	Alta	C. P. R. R.	3,607
16	Altamont	C. P. R. R.	740
17	Alturas	Wheeler	4,365
18	Alturas Hill	Wheeler	4,459
19	Amys' Ranch	Wheeler	1,494
20	Anaheim	C. P. R. R.	130
21	Anderson	Toner	33
22	Anderson, Mt.	Whitney	9,000
23	Angel Island, N. W.	U. S. C. & G. S.	159
24	Angel Island Peak	U. S. C. & G. S.	782
25	Aneta	Toner	161
26	Antelope	C. P. R. R.	154
27	Antelope Ranch	Wheeler	359
28	Antelope Spring	Wheeler	4,272
29	Arab Spring	Wheeler	5,697
30	Arcade	C. P. R. R.	55
31	Arlington Bridge	Wheeler	3,375
32	Ash Springs	Wheeler	1,810
33	Auburn	C. P. R. R.	1,360
34	Auburn	Smithsonian Institute	1,176
35	Aurora	Wheeler	7,449
36	Advisadera, Point	U. S. C. & G. S.	171
37	Azusa	Wheeler	594
38	Babbitt, Camp	Williamson	384
39	Bache, Mt.	U. S. C. & G. S.	3,793
40	Bache, Mt.	Peterman	3,790
41	Bacons' Ranch	Wheeler	4,076
42	Bagley's Ranch	Wheeler	5,387
43	Bah-li-vah Spring	Wheeler	6,284
44	Bakersfield	Wheeler	432
45	Baker's Ranch	Toner	3,285
46	Bald Mountain	Wheeler	5,829
47	Bald Mountain	Wheeler	8,295
48	Bald Rock	Wheeler	7,825
49	Balley, Mt.	Whitney	6,357
50	Ballona	L. A. & I. R. R.	103
51	Bantas	C. P. R. R.	30
52	Bardins	Monterey R. R.	48
53	Bare Mountain	Wheeler	6,039
54	Bares' Ranch, Surprise Valley	Wheeler	4,680
55	Barker's Ranch	Wheeler	594
56	Barnard's Hotel	Wheeler	3,851
57	Batavia	C. P. R. R.	64
58	Battle Creek Meadows	Wheeler	4,700
59	Battle Hill		2,389
60	Baxter's Station	Wheeler	4,115
61	Bear Valley Post Office	Wheeler	2,087
62	Bear Valley, Town Hotel	Wheeler	6,592
63	Beckworth's Pass	Wheeler	5,193
64	Beckworth's Pass	R. R. surveys	4,682
65	Beckworth's Pass	Whitney	5,327
66	Beckworth's Store	Wheeler	4,887
67	Bell Mill	Wheeler	3,681
68	Bello	Cal. P. R. R.	203
69	Benicia Arsenal	U. S. C. & G. S.	6
70	Benicia Barracks	Med. Dept., U. S. A.	64
71	Bennett's Wells, Death Valley	Wheeler	—68
72	Berenda	Toner	256
73	Bidwell	Wheeler	4,612
74	Bidwell Camp	Wheeler	4,647
75	Bidwell Camp	Med. Dept., U. S. A.	4,680
76	Bidwell, Mt.	Wheeler	8,551
77	Bidwell's Bar, South Fork Feather River	Wheeler	342
78	Bielowski	Whitney	3,269
79	Biggs's	C. P. R. R.	124
80	Big Logan	Toner	70
81	Big Meadow Ranch	Wheeler	6,464
82	Big Meadows	Wheeler	4,234
83	Big Oak Flat	Wheeler	2,823

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
84	Big Springs	Wheeler	4,553
85	Big Tree Grove, Calaveras County	Wheeler	4,794
86	Big Tree Station	Wheeler	3,925
87	Birds' Springs	Wheeler	3,949
88	Black Bluff	U. S. C. & G. S.	208
89	Black Mountain	U. S. C. & G. S.	2,811
90	Blackmore's Ranch	Wheeler	2,230
91	Black Ridge	U. S. C. & G. S.	756
92	Black Springs	Wheeler	6,485
93	Blodgett's Ranch	Wheeler	216
94	Blood's Station	Wheeler	6,979
95	Blue Cañon	C. P. R. R.	4,693
96	Bluff Point	U. S. C. & G. S.	177
97	Board Ranch	Wheeler	4,639
98	Boca	Wheeler	5,230
99	Boca	C. P. R. R.	5,531
100	Bodega Head	U. S. C. & G. S.	241
101	Bold's Ranch	Wheeler	141
102	Bonita, Point	U. S. C. & G. S.	283
103	Boneyard Ranch	Wheeler	2,450
104	Bootjack Ranch	Wheeler	2,107
105	Borden	Toner	172
106	Boston Peak	Wheeler	6,519
107	Bower Cave	Wheeler	2,360
108	Box Elder		1,430
109	Boyd's Ranch	Wheeler	622
110	Bozeman's Ranch	Wheeler	3,157
111	Brandy City		3,592
112	Breccia Pass	Goddard	10,150
113	Breckinridge, Mt.	Wheeler	5,693
114	Breckenridge, Mt.	Wheeler	7,418
115	Brewer, Mt.	Whitney	13,886
116	Brewery	Wheeler	2,838
117	Bridgeport	Wheeler	1,357
118	Pridgeport Post Office	Wheeler	6,423
119	Brighton	S. & P. R. R.	42
120	Brighton, cross S. V. R. R.	C. P. R. R.	54
121	Broncho	Wheeler	5,310
122	Brown's Flat	Wheeler	1,964
123	Brown's Peak	Wheeler	5,392
124	Brown's Ranch	Wheeler	1,759
125	Buckeye	Wheeler	4,938
126	Buckhorn Ranch (or Warren Station)	Wheeler	693
127	Buck's Ranch	Wheeler	5,112
128	Buena Vista	Wheeler	323
129	Buena Vista	Nev. Co. N. G. R. R.	2,618
130	Buena Vista Oil Works		790
131	Buffalo Station	Wheeler	4,378
132	Burrows, Mt.	Wheeler	4,267
133	Burst Rock	Wheeler	9,157
134	Bush Hill	U. S. C. & G. S.	482
135	Butte Creek Bridge	Wheeler	4,692
136	Butte Creek House	Wheeler	5,758
137	Butt, Mt.	Wheeler	7,830
138	Byrnes' Ferry	Wheeler	380
139	Cady, Camp	Wheeler	1,894
140	Cahto	Smithsonian Inst.	2,000
141	Cahuenga Pass	Wheeler	750
142	Cajon Pass	Pacific R. R. Reports	4,676
143	Cajon Pass Divide	Wheeler	4,195
144	Cajon Ranch	Pacific R. R. Reports	412
145	Calaveras Grove	Wheeler	4,730
146	Caliente	C. P. R. R.	1,290
147	Caliente	Wheeler	1,314
148	Caliente Springs	Wheeler	3,688
149	California City Point	U. S. C. & G. S.	75
150	Calistoga	C. P. R. R.	331
151	Campo, Signal Station	U. S. Signal Office	2,527
152	Camptonville	Toner	2,388

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
153	Camp Weldon (Mountain)	Wheeler	2,716
154	Canebrake Ranch	Wheeler	3,904
155	Cannelas Ranch	Wheeler	799
156	Cannon	C. P. R. R.	90
157	Cañon de Turruco Pass		4,256
158	Cañon Spring	Wheeler	1,238
159	Cañon Station	Wheeler	2,650
160	Capitan Grande	Pacific R. R. Reports	730
161	Caples Ranch	Wheeler	7,780
162	Caples Spring	Wheeler	5,512
163	Carbondale	C. P. R. R.	222
164	Caribou Bridge, North Fork	Wheeler	2,843
165	Carizzo		431
166	Carlos, Mt.	Whitney	4,977
167	Carmel, Mt.	U. S. C. & G. S.	4,415
168	Carnelian Hot Springs	Wheeler	6,237
169	Carson Cañon Toll House	Wheeler	6,596
170	Carson Pass	Goddard	7,972
171	Carson Pass	Whitney	8,759
172	Carson Pass	Wheeler	8,634
173	Cartago		3,589
174	Carthage, on Owens Lake	Wheeler	3,589
175	Cary, Mt.	Wheeler	9,970
176	Cascade	C. P. R. R.	6,538
177	Castle, Mt.	Wheeler	9,013
178	Castle Peak	Whitney	12,500
179	Castle Rock	Wheeler	9,872
180	Castroville, on line of S. P. R. R.	Monterey R. R.	19
181	Catherines	S. P. R. R.	512
182	Cathedral Rock (lower)	Wheeler	6,430
183	Cathedral Rock (higher)	Wheeler	6,529
184	Cathey's Ranch	Wheeler	1,260
185	Cavallos, Point de los	U. S. C. & G. S.	126
186	Coyote Ridge	U. S. C. & G. S.	1,034
187	Cedar, Mt.	Wheeler	8,308
188	Cedar Point	Toner	5,614
189	Cedarville	Wheeler	4,675
190	Centerville	Wheeler	503
191	Cerro Gordo Landing, Col. River	Wheeler	3,656
192	Cerro Gordo Pass	Wheeler	8,874
193	Chapman's Ranch	Wheeler	4,992
194	Chapperal House	Wheeler	5,076
195	Chemehuevis Pass	K. P. R. R. Surveys	675
196	Chico	C. P. R. R.	193
197	Chico	Smithsonian Inst.	150
198	Chico	Wheeler	177
199	Chinese Camp	Wheeler	1,299
200	Chiquita Peak	Wheeler	8,136
201	Chuckawalla	Wheeler	2,095
202	Cicero	C. P. R. R.	90
203	Cienega	L. A. & I. R. R.	121
204	Cisco	C. P. R. R.	5,934
205	Cisco (site) South Fork Yuba River	Wheeler	5,654
206	Clark Peak	Wheeler	11,295
207	Clark's	Wheeler	3,925
208	Clark's Ranch	Wheeler	4,677
209	Clayton	Smithsonian Inst.	76
210	Clear Lake	Wheeler	5,808
211	Clipper Gap	C. P. R. R.	1,759
212	Cloud Rest	Wheeler	9,772
213	Clover Valley	Wheeler	3,464
214	Cohen's Ranch	Wheeler	281
215	Cohuilla Village	Pacific R. R. Reports	85
216	Colby's Ranch	Wheeler	4,990
217	Cold Spring	Wheeler	3,126
218	Cold Spring	Wheeler	5,375
219	Cold Spring Ranch	Wheeler	565
220	Cole's Ranch	Wheeler	1,221
221	Coleville (blacksmith shop)	Wheeler	5,190

TABLE OF ABTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
222	Colfax	Nev. Co. N. G. R. R.	2,422
223	Colfax	Wheeler	3,022
224	Colfax Junction, with Nevada Co. R. R.	C. P. R. R.	2,422
225	Colona		835
226	Colton	Wheeler	808
227	Colton	C. P. R. R.	965
328	Columbia	Toner	2,314
229	Columbia P. O.	Wheeler	2,157
230	Columbia Rock (above valley)	Wheeler	5,005
231	Conejos	Wheeler	2,565
232	Conejas Ranch	Wheeler	579
233	Conness Peak	Wheeler	12,518
234	Contra Costa	U. S. C. & G. S.	96
235	Cook's Point (Mountain)	Wheeler	6,336
236	Cook's Wells	Pacific R. R. Reports	—62
237	Coomb's Station	Wheeler	2,886
238	Cooper's Ranch	Wheeler	8,406
239	Copperopolis P. O.	Wheeler	1,015
240	Corbett's Ranch	Wheeler	1,075
241	Corcoran, Mt.	Wheeler	14,093
242	Cordelia	C. P. R. R.	11
243	Cordelia	Pacific R. R. Reports	69
244	Cory's Peak	Wheeler	11,326
245	Costa	C. P. R. R.	85
246	Cottonwood	Toner	423
247	Cottonwood Island	Wheeler	787
248	Cottonwood Station	Wheeler	2,488
249	Coulterville	Wheeler	1,665
250	Cow Creek Ranch, Sonora Road	Wheeler	5,905
251	Cow Head Lake	Wheeler	6,041
252	Cow Head Lake Spring	Wheeler	5,329
253	Cow Spring	Wheeler	3,876
254	Cox's Ferry	Wheeler	250
255	Crabtrees	Wheeler	934
256	Crane Flat	Wheeler	6,054
257	Crane Valley	Wheeler	3,185
258	Crater Station		1,000
259	Crescent City	Smithsonian Inst.	12
260	Crescent City	Wheeler	3,306
261	Cress's Ranch	Wheeler	5,157
262	Creston	C. P. R. R.	313
263	Crimea House	Wheeler	1,221
264	Crook, Fort	Medical Dept. U. S. A.	3,390
265	Crow's Ranch, Clover Valley	Wheeler	5,464
266	Crystal Lake	R. R. Reports	5,907
267	Culbertson's	Wheeler	980
268	Culbertson's Vineyard	Wheeler	981
269	Cucamonga	C. P. R. R.	952
270	Cucamonga	Wheeler	1,328
271	Cucamonga Peak	Wheeler	8,529
272	Cucamonga Ranch	Wheeler	1,168
273	Cuddy's Ranch	Wheeler	5,278
274	Cunningham's Ranch	Wheeler	387
275	Curtis	C. P. R. R.	39
276	Daggett's Pass	Goddard	6,824
277	Dahlonega	Wheeler	2,162
278	Dalton's Ranch	Wheeler	568
279	Dana, Mt.	Whitney	13,227
280	Darwin Cañon	Wheeler	3,143
281	Davis	C. P. R. R.	54
282	Dawes Ranch	Wheeler	451
283	Deadfall Bridge	Wheeler	3,426
284	Deadwood Peak	Wheeler	4,451
285	Decoto	C. P. R. R.	68
286	Deep Spring	Wheeler	4,957
287	Deer Creek	Wheeler	4,518
288	Delaney's Ranch	Wheeler	4,840
289	Delano	C. P. R. R.	313
290	Desert Springs	Wheeler	1,989

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
291	Dewser's Station	Wheeler	2,922
292	Devil's Peak	Wheeler	6,910
293	Diablo Point	U. S. C. & G. S.	202
294	Diablo, Monte, Hotel	U. S. C. & G. S.	2,327
295	Diablo, Monte	U. S. C. & G. S.	3,849
296	Dixon	C. P. R. R.	65
297	Donner Lake	R. R. Reports	5,964
298	Donner Lake	Wheeler	5,885
299	Donner Pass	C. P. R. R. Surveys	7,901
300	Donner Pass	Whitney	7,056
301	Doon's Sawmill	Wheeler	3,420
302	Dos Palmas	Wheeler	103
303	Downey	C. P. R. R.	114
304	Downieville	Smithsonian Inst.	2,200
305	Downieville Buttes	Whitney	8,400
306	Downieville Buttes	Wheeler	8,541
307	Drew's Ranch	Wheeler	1,090
308	Dribblesby's Ferry	Pacific R. R. Reports	954
309	Drune Barracks	Medical Dept. U. S. A.	32
310	Dudley's	Wheeler	2,959
311	Duxbury	U. S. C. & G. S.	797
312	Dugan's	S. & P. R. R	1,106
313	Dunderberg Peak	Wheeler	12,289
314	Dutch Flat	C. P. R. R.	3,395
315	Dutch Henry's Ranch	Wheeler	1,195
316	Dutch Hill Mining Camp	Wheeler	4,692
317	Dyer Mountain, near Big Meadows	Wheeler	7,369
318	Eagle Lake	Wheeler	5,115
319	Eagle Mountain	Wheeler	9,933
320	Eagleville	Wheeler	4,632
321	Ebbitt's Pass	P. R. R. Reports	8,793
322	Echo Peak	Wheeler	11,231
323	Edgar's Spring	Wheeler	4,061
324	Eisen Vineyard	Wheeler	358
325	El Dorado Mill	Wheeler	863
326	Elephant, Mt.	Wheeler	10,418
327	Eleven Mile Station, Mariposa Road	Wheeler	5,567
328	Eliot's Ranch, on Little Truckee River	Wheeler	6,233
329	Elizabeth Lake	Wheeler	3,317
330	Elk Grove	C. P. R. R.	53
331	Elk Horn	Pacific R. R. Reports	89
332	Elkhorn Ranch	Wheeler	1,049
333	Elk Valley		3,751
334	Ellis	C. P. R. R.	76
335	Ellis Mountain	Wheeler	8,675
336	Elmira	C. P. R. R.	75
337	El Monte	Wheeler	329
338	El Paso Mines	Wheeler	4,113
339	Emigrants' Gap	C. P. R. R.	5,221
340	Emigrants' Gap	Pacific R. R. Reports	5,221
341	Eureka		5,223
342	Eureka Valley	Wheeler	5,957
343	Excelsior Hotel	Wheeler	4,570
344	Fandango Peak	Wheeler	7,849
345	Far West, Camp	Medical Dept. U. S. A.	175
346	Fears' Station	Wheeler	3,393
347	Ferguson's Mill	Wheeler	1,389
348	Fifteen Mile Creek	Wheeler	1,267
349	Fisherman's Peak	Wheeler	14,448
350	Fishpond Station	Toner	1,900
351	Florence	C. P. R. R.	153
352	Florin	Toner	42
353	Folsom	S. & P. R. R.	182
354	Forest Ranch	Wheeler	2,217
355	Forgay's Ranch	Wheeler	3,381
356	Fornis' Ranch	Wheeler	4,225
357	Forsee's Ranch	Wheeler	3,587
358	Fort Point	U. S. C. & G. S.	186
359	"Forty-nine," Cañon Pass	Wheeler	6,306

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
360	Foster's Bar	Toner	1,371
361	Foster's Station	Wheeler	3,265
362	Fowler's Peak	Wheeler	1,760
363	Francis' Spring	Wheeler	4,220
364	Frank's Lagoon	U. S. C. & G. S.	497
365	Fredonyer's Peak	Wheeler	7,995
366	Freels' Mountain	Wheeler	10,848
367	Fremont	C. P. R. R.	58
368	Frenchman's Cove	Wheeler	5,565
369	Fresno	C. P. R. R.	294
370	Fresno	Wheeler	314
371	Fresno Flat	Wheeler	2,192
372	Fryes'	Wheeler	2,181
373	Fulsom & Hall's Ranch	Wheeler	4,282
374	Furnace Creek	Wheeler	405
375	Furnace Springs	Wheeler	337
376	Galt Junction	C. P. R. R.	49
377	Gavilan	U. S. C. & G. S.	2,816
378	Gavilan	Whitney	3,381
379	Georgetown	Toner	2,433
380	Georgetown Pass	Whitney	7,119
381	Georgetown Pass	C. P. R. R. Surveys	7,154
382	Gilroy	Toner	193
383	Glenville	Wheeler	3,094
384	Gold Run	C. P. R. R.	3,220
385	Gold Spring Ranch	Wheeler	2,014
386	Goodrich's Ranch	Wheeler	4,883
387	Goose Lake	Wheeler	4,697
388	Gordon's Ranch	Wheeler	737
389	Gorman's Ranch	Wheeler	3,838
390	Goshen	C. P. R. R.	278
391	Goshen Junction (with S. P. R. R.)	C. P. R. R.	280
392	Guano Island	U. S. C. & G. S.	28
393	Granite Spring	Wheeler	1,435
394	Granite Springs	Wheeler	4,115
395	Granite Station	Wheeler	1,744
396	Granite Wells	Wheeler	2,080
397	Grapevine Peak	Wheeler	8,528
398	Grapevine Ranch	Wheeler	2,247
399	Grapevine Spring	Wheeler	2,432
400	Grass Lake	Wheeler	8,564
401	Grass Valley		2,090
402	Grass Valley	Nev. Co. N. G. R. R.	2,454
403	Gravel Range	Wheeler	2,987
404	Gray's Ranch	Wheeler	307
405	Gray's Ranch	Wheeler	1,100
406	Green Bluff	U. S. C. & G. S.	486
407	Green Mountain	Wheeler	1,351
408	Green Mountain	Wheeler	1,352
409	Green's Ranch	Wheeler	4,479
410	Greenville	Wheeler	3,544
411	Gridley	Toner	97
412	Griffith's Ranch	Wheeler	473
413	Grizzly Giant, Mariposa Grove	Wheeler	5,838
414	Grizzly Hill	Wheeler (Theod)	5,709
415	Grizzly Peak	Wheeler	11,723
416	Grizzly Peak	Wheeler	10,369
417	Groveland	Wheeler	2,828
418	Gyser's	Wheeler	5,864
419	Haighs'	Wheeler	1,807
420	Hale's	Wheeler	2,739
421	Halfway House	Wheeler	3,359
422	Halloran Spring	Wheeler	3,272
423	Hamilton Mountain	Whitney	4,440
424	Hamilton (near)	Pacific R. R. Reports	260
425	Hardin's	Wheeler	3,396
426	Harkness Mountain, near Big Meadows	Wheeler (Theod)	8,875
427	Harris' Ranch, Madeline Plains	Wheeler	5,339
428	Harris' Station, Amander Road	Wheeler	5,439

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
429	Hart's Ranch	Wheeler	242
430	Haskell's Peak	Wheeler	8,126
431	Hat Mountain	Wheeler	7,676
432	Haughtown Crossing	S. & P. R. R.	85
433	Havilah Town	Wheeler	3,150
434	Hays' Station	Wheeler	5,957
435	Hazel Green	Wheeler	5,550
436	Hazelton Peak	Wheeler	2,960
437	Hazel Valley	Wheeler	3,404
438	Helena, Mount	Whitney	4,343
439	Henness Pass	C. P. R. R. Surveys	7,031
440	Henness Pass	Whitney	6,996
441	Hennessy's Bridge	Wheeler	1,821
442	Henry, Mount	Whitney	2,398
443	Hermit Valley	Wheeler	7,039
444	Hickman's Ranch	Wheeler	1,907
445	High Bluff	U. S. C. & G. S.	533
446	High Hill	U. S. C. & G. S.	490
447	Highland Peak	Wheeler	10,956
448	Hill's Ranch	Pacific R. R. Reports	4,131
449	Hite's Cove	Wheeler	1,601
450	Hodgdon's	Wheeler	4,506
451	Hoffmann Peak	Wheeler	10,872
452	Hogle	C. P. R. R.	76
453	Hollister	Toner	284
454	Homestead	S. & P. R. R.	32
455	Honey Lake	Wheeler	3,949
456	Hooker		543
457	Hope Valley	Williamson	7,072
458	Hornitos Hotel	Wheeler	847
459	Horn Spring	Wheeler	5,477
460	Horseley's Station	Wheeler	3,860
461	Hosselkus' Ranch	Wheeler	3,635
462	Hotchkiss Ranch	Wheeler	2,931
463	Hot Springs	Wheeler	6,080
464	Hot Springs	Wheeler	7,384
465	Hot Springs	Wheeler	7,692
466	Hough's Mountain	Wheeler (Theod)	7,391
467	Hovely's Camp	Wheeler	3,860
468	Hubertville	Toner	980
469	Hughes' Ranch	Wheeler	3,122
470	Humboldt, Fort	Med. Dept., U. S. A.	50
471	Humbug Park	Wheeler	4,847
472	Humpahyamup Pass	P. R. R. Reports	5,351
473	Hunter's Ranch	Wheeler	6,274
474	Hunter's Ranch	Wheeler	6,275
475	Huntington, Mohave River	Wheeler	2,899
476	Hupps' Mill	Wheeler	2,667
477	Hyde's Union Sawmill	Wheeler	5,288
478	Illinois Ranch	Wheeler	1,759
479	Illinoistown	Toner	2,234
480	Independence, Camp	Wheeler	3,957
481	Independence, Camp	Smithsonian Inst.	4,800
482	Indian Gulch	Wheeler	951
483	Indian Valley	Toner	3,280
484	Indian Wells	C. P. R. R.	—20
485	Indian Wells	Wheeler	2,608
486	Ingalls, Mount	Wheeler	8,471
487	Inskip Toll-gate	Wheeler	4,808
488	Ione	C. P. R. R.	287
489	Ivanpah	Wheeler	4,238
490	Jackson	Toner	934
491	Jacksonville	Wheeler	602
492	Jelly's Ranch	Wheeler	360
493	Joe's Peak	Wheeler	9,712
494	John's, Mount	Petermann	8,000
495	Johnson's Pass	Goddard	6,752
496	Johnson's Pass	C. P. R. R. Surveys	7,374
497	Johnson's Pass	Simpson	7,222

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
498	Johnson's Pass	Whitney	7,339
499	Johnson's Ranch	Wheeler	3,460
500	Johnson's Ranch, Bresser Creek	Wheeler	5,643
501	Jones, Fort	Med. Dept., U. S. A.	2,570
502	Jones' Mill, near Dutch Flat		3,416
503	Junction House	Wheeler	3,562
504	Junction House, on Reno and Susanville road, near Beckwith's Pass	Wheeler	4,639
505	Junction with Oregon Branch	C. P. R. R.	163
506	Kaweah Peak	Whitney	14,000
507	Keg Spring, Willow Creek	Wheeler	5,757
508	Kern Lake	Pacific R. R. Reports	398
509	Kernville	Wheeler	2,551
510	Kettle Rock Peak	Wheeler	7,843
511	Keystone House	Wheeler	1,093
512	Keysville		2,558
513	Kincaid's Flat	Wheeler	1,589
514	Kincaid's Ranch	Wheeler	1,771
515	King's Springs, Death Valley	Wheeler	—225
516	Kingston	Petermann	1,118
517	Kirkwood's	Wheeler	7,677
518	Knight's Ferry Bridge	Wheeler	180
519	Knight's Landing	C. P. R. R.	43
520	Kress	Nev. Co. N. G. R. R	2,857
521	La Bayonne	Wheeler	16
522	Lagrange	Wheeler	222
523	Lake City	Wheeler	4,624
524	Lake City Pass	Wheeler	7,035
525	Lakeview	Wheeler	4,851
526	La Laguna Ranch	Wheeler	129
527	Lambert's Soda Spring	Wheeler	8,558
528	La Motte's	Wheeler	6,491
529	Lane's Crossing, Mojave River	Wheeler	2,819
530	Lankershin's Ranch	Wheeler	563
531	Lassen's Butte	Wheeler	10,437
532	Lassen's Butte	Whitney	10,577
533	Lathrop Junction with Visalia Division	C. P. R. R.	26
534	Latrobe	S. P. R. R.	782
535	Lava Bed Station	Wheeler	446
536	Lawrence	Toner	66
537	Leach's Point	Wheeler	3,409
538	Leek Spring	Wheeler	7,242
539	Lewis' Ranch	Wheeler	956
540	Lewis Ranch, near Loyalton	Wheeler	4,949
541	Lievre Ranch	Wheeler	3,756
542	Lillie's Ranch	Wheeler	3,647
543	Lime Point Bluff	U. S. C. & G. S.	495
544	Lincoln	C. P. R. R.	161
545	Lion's Head	Wheeler	1,693
546	Little Yosemite	Wheeler	6,442
547	Livermore	C. P. R. R.	485
548	Livermore Pass	Whitney	686
549	Liverpool Landing, Colorado River	Wheeler	606
550	Lobos Point	U. S. C. & G. S.	326
551	Lobos Point	U. S. C. & G. S.	378
552	Lodi	C. P. R. R.	55
553	Lomo	Wheeler	3,848
554	Lone Pine	Wheeler	3,810
555	Longville	Wheeler (Theod.)	4,309
556	Lookout Hill	Wheeler	4,214
557	Lookout Mountain	Wheeler	9,670
558	Loomis' Ranch	Wheeler	4,357
559	Lopez Ranch	Wheeler	3,248
560	Los Angeles	C. P. R. R.	265
561	Los Angeles	Wheeler	326
562	Los Angeles	Pacific R. R. Reports	250
563	Los Angeles, San Pedro Dessa	L. A. & I. R. R	260
564	Los Angeles, Signal Station	U. S. Signal Office	350
565	Los Encinos Ranch	Wheeler	772

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
566	Los Pozos Ranch	Wheeler	259
567	Los Toros	Wheeler	203
568	Lott's Diggins	Wheeler	6,310
569	Luther's Pass	Goddard	7,185
570	Luther's Pass	Simpson	7,505
571	Lyell, Mt.	Wheeler	13,190
572	Lyell, Mt.	Whitney	13,217
573	Lyon's Ranch	Wheeler	1,397
574	McBride's	Wheeler	5,561
575	McBride's Peak	Wheeler	13,441
576	McConnahas'	Wheeler	3,981
577	McCumber's Mill	Pacific R. R. Reports	3,491
578	McDonald Peak	Wheeler	7,954
579	McDonald Ranch	Wheeler	5,297
580	McGill, Mt.	Wheeler (Theod.)	9,214
581	McKesick's Peak	Wheeler	7,083
582	McKesick's Ranch	Wheeler	4,429
583	McQuade's	Wheeler	1,888
584	Macon	Toner	450
585	Madeline Hat Peak	Wheeler	7,676
586	Madeline Pass	P. R. R. Reports	5,067
587	Malaga	Wheeler	2,320
588	Mapes	Wheeler	5,039
589	Mare Island, N. E.	U. S. C. & G. S.	283
590	Mare Island, N. W.	U. S. C. & G. S.	101
591	Mare Island	U. S. C. & G. S.	29
592	Marin Island	U. S. C. & G. S.	74
593	Marion	U. S. C. & G. S.	74
594	Mariposa	Wheeler	1,962
595	Mariposa Town Hall	Wheeler	1,971
596	Mariposa Post Office	Wheeler	1,942
597	Mariposa Peak	Whitney	3,700
598	Markleeville	Wheeler	5,525
599	Marlett's Lake	Wheeler	7,750
600	Marlett's Peak	Wheeler	8,031
601	Marlett's Ranch	Wheeler	8,074
602	Marl Spring	Pacific R. R. Reports	3,793
603	Martinez, East	U. S. C. & G. S.	187
604	Martinez C. H.	U. S. C. & G. S.	27
605	Martin's	Monterey R. R.	16
606	Martin's	Monterey R. R.	1,982
607	Martin's Ranch	Wheeler	2,055
608	Marysville	C. P. R. R.	67
609	Marysville	Smithsonian Institute	80
610	Master's Hill	U. S. C. & G. S.	2,445
611	Matthews' Ranch	Wheeler	6,294
612	Maturango, Mt.	Wheeler (Theod.)	8,844
613	Mayfield	Toner	34
614	Mayhews	S. & P. R. R.	58
615	Meade, Mt.	Wheeler	10,540
616	Meadow Mountain	Wheeler	11,734
617	Meadow Valley	Wheeler	3,757
618	Melrose	C. P. R. R.	18
619	Menatchey Valley	Wheeler	9,503
620	Merced	C. P. R. R.	173
621	Merced Falls	Wheeler	300
622	Merced, Mt.	Wheeler	11,413
623	Merritt's	C. P. R. R.	54
624	Mesquite Spring	Wheeler	2,010
625	Mesquite Wells		3,674
626	Middle Lake, Surprise Valley	Wheeler	4,551
627	Midway	C. P. R. R.	356
628	Mill Creek, Sonora road	Wheeler	7,076
629	Miller, Fort	Med. Dept., U. S. A.	402
630	Miller's Ranch	Wheeler	4,055
631	Mills of Madera Flume and Trading Co.	Wheeler	4,499
632	Milton	Wheeler	376
633	Milton	Wheeler	5,845
634	Mineral Bar	Toner	1,121

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
635	Mitchell's Ranch	Wheeler	4,285
636	Moccasin, Mt.	Wheeler	2,791
637	Modesto	C. P. R. R.	93
638	Mojave	C. P. R. R.	2,751
639	Mokelumne	Toner	5,523
640	Mokelumne, Mt.	Wheeler	9,467
641	Molate Island	U. S. C. & G. S.	169
642	Molate Point	U. S. C. & G. S.	133
643	Mono Lake	U. S. Geol. Survey	6,730
644	Mono Pass	Whitney	10,765
645	Monte	Toner	354
646	Monte Diablo	Whitney	3,856
647	Monterey	Monterey R. R.	7
648	Monterey	Med. Dept., U. S. A.	140
649	Moonlight Valley	Wheeler	5,433
650	Moquelumne Hill	Smithsonian Institute	1,502
651	Moran's Ranch	Wheeler	3,984
652	Mormon Bar	Wheeler	1,630
653	Morocojo	Monterey R. R.	15
654	Morongo Basin	Toner	1,500
655	Morrow, Mt.	Wheeler	2,065
656	Mosquito Spring	Wheeler	2,010
657	Mountain House	Wheeler	5,641
658	Mud Spring, Amador road	Wheeler	5,973
659	Mud Springs	Wheeler	4,671
660	Murphy	U. S. C. & G. S.	2,703
661	Murphy's Cabin, Lake Tenaiya	Wheeler	7,971
662	Murphy's Mining Village	Wheeler	2,195
663	Murphy's Ranch, Buffalo Salt Works	Wheeler	3,845
664	Myers' Ferry	Wheeler	7,434
665	Myers' Station	Wheeler	3,759
666	Nadean's Station	Wheeler	2,394
667	Napa	C. P. R. R.	18
668	Napa Junction	C. P. R. R.	8
669	Napa Junction (Adalante)	C. P. R. R.	76
670	Nash's Ranch	Wheeler	4,431
671	Nelson	Toner	125
672	Nevada City	Nev. Co. N. G. R. R.	2,531
673	Newbury Peak	Wheeler	3,375
674	Newbury Park	Wheeler	830
675	Newcastle	C. P. R. R.	956
676	Newhall	C. P. R. R.	1,152
677	Newhall's Ranch	Wheeler	974
678	New Pass	P. R. R. Reports	3,164
679	New York Tent	Wheeler	1,143
680	Niagara Creek, Sonora road	Wheeler	6,690
681	Nicholas (near)	Pacific R. R. Reports	289
682	Nichols Point	Wheeler	6,262
683	Niles Junction with San José Branch	C. P. R. R.	88
684	Nimshew	Wheeler	2,451
685	Noble's Pass	Wheeler	5,963
686	Noble's Pass	Williamson	6,260
687	Noman's Spring	Wheeler	3,735
688	Nora	C. P. R. R.	153
689	Nordhoff	Wheeler	819
690	North Dome (above valley 3,633)	Wheeler	7,484
691	North End Peak	Wheeler	8,472
692	Northups (Excelsior Hotel)	U. S. C. & G. S.	4,519
693	Norwalk	C. P. R. R.	95
694	Nott's Ranch	Wheeler	7,110
695	Null's Ranch	Wheeler	1,299
696	Oakdale	Wheeler	149
697	Oak Knoll	C. P. R. R.	102
698	Oakland	C. P. R. R.	12
699	Oakland Wharf	C. P. R. R.	14
700	Observation Peak	Wheeler	8,009
701	Ogburn's Ranch	Wheeler (Theod.)	2,270
702	Olancha Peak	Wheeler	12,250
703	Old Bony Mountain	Wheeler	1,892

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
704	Old Kimshew Settlement	Wheeler	4,992
705	Omjumi, Mountain	Whitney	8,378
706	Omjumi, Mountain	Wheeler	8,292
707	Orange	C. P. R. R.	134
708	Oroville	Wheeler	188
709	Oso Meadows	Wheeler	5,982
710	Oso Mountain	Whitney	3,363
711	Owens' River Bridge	Wheeler	3,618
712	Pacheco	U. S. C. & G. S.	21
713	Pacheco Pass	Whitney	1,470
714	Pacheco's Peak	Whitney	2,845
715	Pacific House	Wheeler	3,451
716	Pah Ute Mines	Wheeler	6,607
717	Pah Ute Peak	Wheeler	8,342
718	Pah Ute Springs	Wheeler	2,849
719	Pajaro	Toner	22
720	Paleta Peak	Wheeler	4,507
721	Palmer's Ranch	Wheeler	2,346
722	Pampa	Wheeler	871
723	Panamint	Wheeler	6,605
724	Panamint Station	Wheeler	3,549
725	Panoche Pass	Whitney	2,500
726	Panola	Toner	48
727	Paradise	Toner	125
728	Paris	C. P. R. R.	400
729	Park	L. A. & I. R. R.	178
730	Parker's Ranch	Wheeler	4,136
731	Parrott's (formerly Pandola) Ferry	Wheeler	834
732	Peach Spring	Wheeler	5,303
733	Peddler's Hill	Wheeler	6,831
734	Peña Blanca (Haigh's Ranch)	Wheeler	1,807
735	Peninsula Hill	U. S. C. & G. S.	367
736	Penole, Point	U. S. C. & G. S.	68
737	Penryn	Toner	624
738	Perkins	S. P. R. R.	51
739	Petalume Creek	U. S. C. & G. S.	111
740	Phillips' Ranch	Wheeler	6,999
741	Phillips' Ranch	Wheeler	242
742	Phillips' Station	Wheeler	6,871
743	Pilot Knob	Wheeler	5,525
744	Pilot Peak	Whitney	7,605
745	Pinos Mountain	Petermann	9,500
746	Pinto Rock	Wheeler	3,903
747	Piute Point	K. P. R. R. Surveys	2,579
748	Placerville	Toner	2,109
749	Placerville	Williamson	1,9[illegible]5
750	Placerville Post Office	Wheeler	1,893
751	Plainsburgh	Toner	209
752	Pleasanton	C. P. R. R.	353
753	Pleasant Valley	Wheeler	2,405
754	Point of Rocks	Wheeler	2,542
755	Porcupine Flat	Wheeler	7,749
756	Potraro	Wheeler	1,028
757	Prattville	Wheeler	4,394
758	Priest's Hotel	Wheeler	2,558
759	Princeton	Wheeler	2,104
760	Probasco's Ranch	Wheeler	973
761	Pulgas Base, East End	U. S. C. & G. S.	19
762	Pulgas Base, West End	U. S. C. & G. S.	129
763	Pyramid Mountain	Wheeler	10,127
764	Quincy	Wheeler	3,381
765	Quiqualmingo	Toner	1,084
766	Railroad Flat	Wheeler	2,006
767	Rancho del Chino y de Jurupa	Med. Dept. U. S. A.	1,000
768	Ravenna	C. P. R. R.	2,347
769	Rawhide Camp	Wheeler	1,556
770	Rawson	Wheeler	228
771	Read	U. S. C. & G. S.	474
772	Reading, Fort	Pacific R. R. Reports	596

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation, Feet.
773	Reading	Pacific R. R. Reports	675
774	Reading	Pacific R. R. Reports	674
775	Reading	Med. Dept. U. S. A.	518
776	Red Bluff	Wheeler	307
777	Red Bluff	Williamson	370
778	Red Bluff	C. P. R. R.	308
779	Red Bluff Signal Station	U. S. Sig. Office	324
780	Redding	C. P. R. R.	556
781	Red Hill Station	U. S. C. & G. S.	188
782	Redmans Ranch	Wheeler	1,181
783	Red Rock Station	Wheeler	2,394
784	Red Slate Peak	Whitney	13,400
785	Redwood City	Toner	10
786	Reilly's Station	Wheeler	1,477
787	Reservoir House	Wheeler	1,013
788	Reservoir in Concord Valley	Wheeler	202
789	Reynolds' Ferry	Wheeler	543
790	Rhett Lake	P. R. R. Reports	4,014
791	Richardson	U. S. C. & G. S.	1,116
792	Richmond Point	U. S. C. & G. S.	192
793	Rincon	Toner	2,050
794	Ripley Mountain	Petermann	7,500
795	Ritgers' Ranch	Wheeler	4,345
796	Roberts' Ferry	Wheeler	184
797	Robertson's	Wheeler	819
798	Roble	Toner	179
799	Rocklin	C. P. R. R.	249
800	Rock Spring	Pacific R. R. Reports	4,898
801	Rocky Island	U. S. C. & G. S.	157
802	Rook's Ranch	P. R. R. Reports	4,181
803	Rose Springs	Wheeler	3,545
804	Ross Mountain	U. S. C. & G. S.	2,205
805	Routiers	S. P. R. R.	72
806	Rowland's Ranch	Wheeler	6,222
807	Rutherford	C. P. R. R.	168
808	Sackett's Wells	Toner	312
809	Sacramento	C. P. R. R.	30
810	Sacramento	Smithsonian Inst.	82
811	Sacramento	Williamson	81
812	Sacramento Signal Station	U. S. Signal Office	70
813	Saddle (Malaga) Mountain	Wheeler	2,896
814	Saint Clair Ranch	Wheeler	1,961
815	Saint Helena	C. P. R. R.	244
816	Salinas City		42
817	Salsbury	S. P. R. R.	126
818	Salt Wells	Wheeler	117
819	San Andreas	Wheeler	1,033
820	San Antonio Peak	U. S. C. & G. S.	9,931
821	San Antonio Peak	Wheeler	10,191
822	San Benito	Smithsonian Inst.	140
823	San Benito Pass	K. P. R. R. Surveys	2,700
824	San Bernardino	Wheeler	950
825	San Bernardino Mountain	Whitney	11,600
826	San Bernardo	Pacific R. R. Reports	1,118
827	San Bruno	Toner	16
828	San Buenaventura	Toner	12
829	San Carlos Peak	Whitney	4,977
830	Sand Creek	C. P. R. R.	2,315
831	Sand Knoll	U. S. C. & G. S.	227
832	San Diego	Emory	30
833	San Diego Mission	Pacific R. R. Reports	64
834	San Diego Signal Station	U. S. Signal Office	67
835	San Emigdio Store	Wheeler	788
836	San Fernando	C. P. R. R.	1,066
837	San Fernando	Wheeler	1,034
838	San Fernando Pass	Pacific R. R. Reports	1,940
839	San Fernando Peak	Wheeler	3,793
840	San Fernando Tunnel, south mouth	Wheeler	1,429
841	San Felipe	Pacific R. R. Reports	2,176

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
842	San Felipe	Pacific R. R. Reports	2,456
843	San Francisco, Signal Station	U. S. Signal Office	60
844	San Francisco, Presidio	Med. Dept. U. S. A.	150
845	San Francisco	U. S. C. & G. S.	384
846	San Francisquito Cañon	Wheeler	2,382
847	San Francisquito Pass	P. R. R. Reports	3,718
848	San Gabriel	Wheeler	419
849	San Gabriel Church	Wheeler	481
850	San Gabriel Mine	Wheeler	1,703
851	San Gabriel Peak		6,232
852	San Gabriel Range	Whitney 4,500 to	6,500
853	San Gorgonio	C. P. R. R.	2,560
854	San Gorgonio Pass	P. R. R. Reports	2,800
855	San Gorgonio Pass	T. & P. R. R.	2,621
856	San Isabel Rancho	Toner	2,957
857	San Jacinto Mountain	Wheeler	10,987
858	San José	C. P. R. R.	91
859	San José	U. S. C. & G. S.	118
860	San Leandro	C. P. R. R.	48
861	San Lorenzo	Toner	35
862	San Luis Obispo	Toner	402
863	San Luis Pass	P. R. R. Reports	1,556
864	San Luis Rey	Med. Dept. U. S. A.	20
865	San Mateo	Toner	23
866	San Miguel	Toner	616
867	San Pablo Point	U. S. C. & G. S.	97
868	San Pascual	Emory	716
869	San Pedro	Pacific R. R. Reports	30
870	San Pedro Point	U. S. C. & G. S.	356
871	San Pedro Hill	Wheeler	1,462
872	San Quentin, Point	U. S. C. & G. S.	173
873	Santa Ana	U. S. C. & G. S.	3,620
874	Santa Ana	C. P. R. R.	137
875	Santa Ann Hotel	Wheeler	141
876	Santa Barbara	Smithsonian Institute	20
877	Santa Buenaventura	Wheeler	146
878	Santa Catalene	Toner	3,000
879	Santa Clara	Smithsonian Institute	98
880	Santa Cruz Station	U. S. C. & G. S.	359
881	Santa Cruz Point	U. S. C. & G. S.	32
882	Santa Isabella		3,050
883	Santa Isabella Rancho	Pacific R. R. Reports	2,957
884	Santa Monica	L. A. & I. R. R.	20
885	Santa Monica	Wheeler	15
886	Santa Paula	Wheeler	384
887	Santa Rosa Valley	Wheeler	175
888	San Vicente	L. A. & I. R. R.	167
889	Say-qui-to Spring	Wheeler	5,553
890	Schaffers, Mount	Wheeler	6,864
891	School House	S. P. R. R.	109
892	Schultz, Mount	Wheeler	2,275
893	Scodie's Ranch	Wheeler	2,716
894	Semi Pass	P. R. R. Reports	1,577
895	Sentinel Dome (above valley 4,160)	Wheeler	8,011
896	Sesma	Toner	229
897	Sevastapol Flat	Wheeler	2,210
898	Seven Palms	C. P. R. R.	1,126
899	Shafer's Station	Wheeler	4,026
900	Shasta		1,160
901	Shasta, Mount	Whitney	14,442
902	Shasta, Mount (timber line on)		8,000
903	Shaw's Flat	Toner	2,270
904	Shaw's Flat	Wheeler	2,036
905	Shaw's Ranch	Wheeler	6,311
906	Shear's Bridge	Wheeler	2,007
907	Sheep Head	Wheeler	3,914
908	Sheffer's Hot Springs	Wheeler	4,094
909	Sheridan		113

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
910	Shingle Springs	S. P. R. R.	1,427
911	Shinn's Ranch	Wheeler	5,040
912	Shoo-fly Bridge	Wheeler	3,071
913	Shumway's Ranch	Wheeler	5,067
914	Sierra Valley	Wheeler	4,910
915	Sierravile, Junc. of S. T. and L. Road	Wheeler	4,904
916	Sierraville, Post Office	Wheeler	4,880
917	Silliman, Mt.	Whitney	11,623
918	Silver Creek	Toner	3,700
919	Silver Lake Hotel	Wheeler	7,174
920	Silver Mt.	Whitney	10,934
921	Silver Mountain City	Wheeler	6,446
922	Silver Mountain Pass	Whitney	8,793
923	Simi Ranch	Wheeler	674
924	Smith's Ranch	Wheeler	1,047
925	Smoke Creek Depot	Wheeler	4,163
926	Snelling Post Office	Wheeler	252
927	Snider's Store	Wheeler	4,925
928	Snow's Hotel	Wheeler	5,217
929	Soap Spring	Wheeler	706
930	Soda Lake	Pacific R. R. Reports	1,002
931	Soda Lake	Wheeler	1,128
932	Soledad City	Wheeler	2,513
933	Soledad Pass	A. & P. R. R. Surveys	3,215
934	Solfatara	Wheeler	5,908
935	Sonoma Mountain	U. S. C. & G. S.	2,292
936	Sonora Mountain	Wheeler	11,478
937	Sonora Pass	P. R. R. Reports	10,115
938	Sonora Post Office	Wheeler	1,816
939	Soto	Toner	186
940	South Dome (lip) (above valley 4,953)	Wheeler	8,804
941	South Fork Mountain	Wheeler	7,408
942	Spadra	C. P. R. R.	705
943	Spadra	Wheeler	802
944	Spanish Ranch	Wheeler	3,636
945	Sprague's Ranch	Wheeler	2,950
946	Springville	Wheeler	48
947	Stanford Mountain	Whitney	9,175
948	Starr King Mt. (above valley 5,171)	Wheeler	9,022
949	State Line Peak	Wheeler	8,405
950	Stevens Bar Ferry	Wheeler	614
951	Stevens Mountain	Wheeler	10,011
952	Stevens Ranch, Hope Valley	Wheeler	7,382
953	Stockton, Junc. with S. & V. & S. & C. R.R.'s	C. P. R. R.	23
954	Stockton's Cabin	Wheeler	5,877
955	Stockton Mill	Wheeler	4,639
956	Stokes Mountain	Wheeler	2,069
957	Stonebreakers	Wheeler	4,360
958	Stony Point		500
959	Storms	Nevada County N. G. R. R.	2,424
960	Strawberry	Wheeler	5,238
961	Strawberry Station (toll house)	Wheeler	5,695
962	Strawberry Valley	Toner	3,567
963	Strawberry Valley	Williamson	5,707
964	Sugar Loaf Mountain	Wheeler	8,416
965	Sulphur Peak	U. S. C. & G. S.	3,471
966	Sulphur Spring Ranch	Wheeler	4,466
967	Summit Peak	Wheeler	8,301
968	Summit Post Office, west of Beckwith's Pass	Wheeler	4,875
969	Summit Station	Wheeler	6,983
970	Summit Valley	Toner	6,765
971	Sumner	C. P. R. R.	415
972	Sunday Peak	Wheeler	8,335
973	Sunday Peak	Wheeler	11,089
974	Sunoe	Toner	264
975	Surveyors' Wells	Wheeler	3,567
976	Susanville	Wheeler	4,195

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
977	Suspension Bridge, Mokelumne River	Wheeler	2,092
978	Sutter	Toner	919
979	Swann's Ranch, E. Walker River	Wheeler	5,042
980	Sweetwater Mountain	Wheeler	11,778
981	Sycamore		302
982	Sycamore Grove	Wheeler	447
983	Tahoe City	Wheeler	6,252
984	Tahoe Lake	R. R. Reports	6,247
985	Tamalpais, Mount	Whitney	2,597
986	Tamarac		6,209
987	Tamarack Flat	Wheeler	6,234
988	Tannery	Wheeler	4,400
989	Tapo Ranch	Wheeler	1,373
990	Tassett		83
991	Taylor's Ranch	Wheeler	1,047
992	Taylorville	Wheeler	3,479
993	Tehachapai, Mount	Wheeler (Theod.)	9,214
994	Tehachapai Pass	Wheeler	3,832
995	Tehama	C. P. R. R.	222
996	Tejon, Fort	Med. Dept. U. S. A.	3,240
997	Tejon, Fort	Wheeler	3,245
998	Tejon Pass	P. R. R. Reports	5,364
999	Tejon Ranch	Wheeler	1,450
1000	Telegraph Hill	U. S. C. & G. S.	300
1001	Telescope Mountain	Wheeler (Theod.)	10,937
1002	Temescal Mountain	Wheeler (Theod.)	5,730
1003	Thomas Ranch	Wheeler	3,772
1004	Thompson	C. P. R. R.	9
1005	Thompson's	Wheeler	2,114
1006	Thompson's Ferry	Wheeler	188
1007	Thompson's Peak	Wheeler	7,752
1008	Thunder Mountain	Wheeler	9,121
1009	Tilley's Ranch	Wheeler	2,609
1010	Tipton	C. P. R. R.	267
1011	Todos Santos Pass	P. R. R. Reports	637
1012	Toolucha Peak	Wheeler	7,022
1013	Tomales Bay	U. S. C. & G. S.	673
1014	Topsail Rock	U. S. C. & G. S.	81
1015	Towler's, Napa Valley		369
1016	Town Talk	Nev. Co. N. G. R. R.	2,774
1017	Tragedy Spring	Wheeler	7,989
1018	Trinchera	Wheeler	7,567
1019	Trinidad		5,820
1020	Trout Meadows	Wheeler	5,998
1021	Truckee	C. P. R. R.	5,819
1022	Truckee	Wheeler	5,795
1023	Truckee Pass	P. R. R. Reports	7,200
1024	Truebody	C. P. R. R.	88
1025	Tulare	C. P. R. R.	282
1026	Tulare Lake	Pacific R. R. Reports	398
1027	Tull Flat	Wheeler	5,594
1028	Tullock	Toner	106
1029	Tuolumne Grove	Wheeler	5,794
1030	Turner's Ranch, Sierra Valley	Wheeler	4,904
1031	Tuttletown	Wheeler	1,321
1032	Twin Lake	Wheeler	5,106
1033	Twin Peak	Wheeler	8,824
1034	Twin Peaks	Whitney	8,925
1035	Twist's Ranch	Wheeler	1,121
1036	Tyler's Ranch	Wheeler	4,802
1037	Uhl's Ranch	Wheeler	2,662
1038	Union Camp	Smithsonian Institute	54
1039	Union Hill	Nev. Co. N. G. R. R.	2,706
1040	Vacaville	Toner	175
1041	Vala Citron	Emory	1,539
1042	Vallecito	Toner	1,643
1043	Vallecito Post Office	Wheeler	1,748

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
1044	Vallejo	U. S. C. & G. S.	87
1045	Vallejo	U. S. C. & G. S.	371
1046	Vallejo (North)	C. P. R. R.	26
1047	Vallejo (South)	C. P. R. R.	13
1048	Vergennes Ranch	Wheeler	940
1049	Vina		211
1050	Visalia	Williamson	384
1051	Visalia, Signal Station	U. S. Signal Office	348
1052	Volcano	Wheeler	2,075
1053	Wabler Lake House	Wheeler	6,868
1054	Wades' Meadows	Wheeler	4,567
1055	Wades' Peak	Wheeler	7,153
1056	Wahguyhe Mountain	Wheeler (Theod.)	8,527
1057	Walker's Pass	P. R. R. Reports	5,302
1058	Walker's Pass	Wheeler	5,322
1059	Wallace's Ranch, Warner Lake	Wheeler	4,487
1060	Walnut Grove	C. P. R. R.	368
1061	Warm Springs	C. P. R. R.	46
1062	Warm Springs, Sonora Road	Wheeler	7,385
1063	Warner's Pass	P. R. R. Reports	3,870
1064	Warner's Ranch	P. R. R. Reports	3,021
1065	Warren's Peak	Wheeler	9,668
1066	Washington, Mount	Wheeler	10,802
1067	Washington Quartz Mill	Wheeler	1,032
1068	Watsonville		45
1069	Waucoba Peak	Wheeler	11,267
1070	Webster	C. P. R. R.	24
1071	Welden	Wheeler	2,668
1072	Welds	Wheeler	2,217
1073	Wellington Mountain	Wheeler	7,665
1074	West Point	Wheeler	2,749
1075	West's Ranch	Wheeler	566
1076	Wheatland	C. P. R. R.	84
1077	White Granite Mountain	Wheeler	7,045
1078	White Rock	S. P. R. R.	495
1079	Whitney	Wheeler	10,051
1080	Whitney Meadows	Wheeler	9,371
1081	Whitney, Mt.	Whitney	14,898
1082	Wellington Mountain	Wheeler	7,665
1083	Wild Rose Spring	Wheeler	4,683
1084	Wiley's Station, Amador Road	Wheeler	5,027
1085	Williamson River	Wheeler	4,387
1086	Williamson's Lake		2,588
1087	Willow Lake	Wheeler	5,382
1088	Willow Ranch	Wheeler	4,275
1089	Willow Spring	Wheeler	420
1090	Willow Spring (head of Willow Creek)	Wheeler	5,084
1091	Willow Tree Spring	Wheeler	2,500
1092	Wilson's Ranch	Wheeler	1,115
1093	Woodford's	Wheeler	5,676
1094	Woodland, Junction with N. R. R.	C. P. R. R.	63
1095	Woodland	U. S. C. & G. S.	58
1096	Woods Peak	Whitney	10,552
1097	Workman's Hill	Wheeler	1,263
1098	Workman's Ranch	Wheeler	362
1099	Wright Lake	P. R. R. Reports	4,470
1100	Yellowbally	Petermann	8,000
1101	Yankee Jim's		3,185
1102	Yerba Buena	U. S. C. & G. S.	345
1103	Yosemite Valley	Whitney	4,060
1104	Yosemite Valley (cliffs and domes about it range from 7,000 to 9,000 ft. above sea)	Williamson	3,935
1105	You Bet	Nev. Co. N. G. R. R.	2,172
1106	Yountville	C. P. R. R.	97
1107	Yountville	Cal. P. R. R.	105
1108	Yreka	Williamson	2,731
1109	Yreka Gap	Whitney	6,642

TABLE OF ALTITUDES—Continued.

No.	Station.	Elevation. Feet.
1110	Alleghany, Sierra County	4,375
1111	Altaville, Calaveras County	1,577
1112	American Mine, Nevada County	1,843
1113	Amador City, Amador County	862
1114	Angels, Calaveras County	1,394
1115	Aqueduct City, Amador County	2,435
1116	Argus Peak, Inyo County	6,333
1117	Atkinson's Grade, San Diego County, foot	416
1118	Atkinson's Grade, San Diego County, first bench	726
1119	Atkinson's Grade, San Diego County, summit	1,220
1120	Bald Mountain, Calaveras County, summit	1,801
1121	Bald Mountain, Sierra County, mouth of tunnel	4,489
1122	Ballena Valley, San Diego County	2,440
1123	Banner, San Diego County	2,800
1124	Birchville, Nevada County	1,683
1125	Blacksmith's Flat, El Dorado County	3,831
1126	Blue Tent, Nevada County	3,108
1127	Bonaparte's Hat, Placer County, summit	8,661
1128	Borax Flat, Inyo County	1,800
1129	Borax Works, Inyo County	1,816
1130	Boston Ranch	1,500
1131	Bottle Hill, El Dorado County, crest	2,570
1132	Bowman Dam, Nevada County	5,393
1133	Brady's, Yuba County	211
1134	Bridgeport, Nevada County	1,500
1135	Brownsville, Yuba County	2,125
1136	Buck's Bar, El Dorado County	1,628
1137	Bunker Hill, Sacramento County	267
1138	Burn's Ranch, El Dorado County	2,518
1139	Cajon Ridge, San Diego County	510
1140	Cajon Valley, San Diego County	220
1141	Cajon Valley, San Diego County, eastern rim	375
1142	Canada Hill, Placer County, summit	7,091
1143	Canada Hill, Placer County, Yank's Cabin	6,217
1144	Cave of the Catacombs, Calaveras County	1,708
1145	Centerville, Pilot Hill Post Office, El Dorado County	1,191
1146	Cherokee Flat, Butte County	1,187
1147	Cherokee, Nevada County	2,575
1148	Chili Bar, El Dorado County	931
1149	Christmas Hill, Nevada County, top of	3,225
1150	Cold Spring, Mountain Summit, Placer Couty	3,679
1151	Coleman's Grade, San Diego County, top, five miles from Julian	3,400
1152	Columbia Hill, Nevada County	2,958
1153	Coso, Inyo County	5,884
1154	Coso Mines, Inyo County	6,000
1155	Coso Peak, Inyo County	8,425
1156	Damascus, Placer County	4,006
1157	Dardanelles, Placer County, bed rock	2,677
1158	Dark Cañon, El Dorado County	4,229
1159	Deadwood, Placer County	3,951
1160	Dirty Flat, El Dorado County	2,355
1161	Dogtown (Magalia), upper, Butte County	2,150
1162	Dogtown (Magalia), lower, Butte County	2,080
1163	Doon's House, Butte County	2,940
1164	Douglas Flat, Calaveras County	1,986
1165	Downieville Trail, Summit of, between Rock Creek and Forest City, Sierra County	5,404
1166	Drytown, Amador County	642
1167	Eagle Borax Works, Inyo County	—69
1168	Empire Flat, Nevada County	1,716
1169	Empire Ranch, Yuba County	840
1170	Fairplay, El Dorado County	2,385
1171	Fiddler's Green, Placer County	4,123
1172	Fiddletown, Amador County	1,693
1173	Forbestown, Butte County	2,625

TABLE OF ALTITUDES—Continued.

No.	Station.	Elevation. Feet.
1174	Forest City, Sierra County	4,465
1175	Forest Hill, Placer County	3,237
1176	Forney's, El Dorado County	4,173
1177	Foster's, San Diego County	260
1178	French Corral, Nevada County	1,566
1179	Funeral Mountains, highest peaks, Inyo County	6,754
1180	Georgia Slide, El Dorado County	2,330
1181	Geyser's Springs, Sonoma County	1,900
1182	Gibsonville, Sierra County	5,500
1183	Granite Chief, summit, Placer County	9,144
1184	Greenwood, El Dorado County	1,610
1185	Gregory Mountain, El Dorado County	3,525
1186	Grizzly Flat, El Dorado County	3,949
1187	Grizzly Flat, Placer County	2,982
1188	Gurley's, Yuba County	172
1189	Halfway House, San Diego County (road from San Diego to Julian)	180
1190	Highland Springs, Lake County	1,700
1191	Horse Camp Springs, Inyo County	4,690
1192	Howard Springs, Lake County	2,225
1193	Hunsaker's Grade, San Diego County (four miles from Nuevo)	1,760
1194	Hunsaker's Grade, San Diego County, summit	2,230
1195	Hyatt's, Nevada County	1,259
1196	Indian Diggings, Amador County	3,162
1197	Iowa Hill, Placer County	2,873
1198	Jackson, Amador County	1,243
1199	Jackson Valley, Buttes, summit of	829
1200	Jamison City, Plumas County	4,800
1201	Johnstown, or Garden Valley, El Dorado County	1,951
1202	Jones Hill, El Dorado County, summit of	2,343
1203	Julian City, San Diego County	4,000
1204	Keeler, Inyo County	3,656
1205	King's Hill, Placer County	2,538
1206	Lane's Springs, Calaveras County	1,000
1207	La Porte, Plumas County	4,993
1208	Last Chance, Placer County	4,583
1209	Little Grass Valley, Plumas County	5,025
1210	Little Spanish Hill, crest of, El Dorado County	2,321
1211	Little York, Nevada County	2,839
1212	Logtown, El Dorado County	1,939
1213	Lolo Montez Diggings, Nevada County	2,489
1214	Lone Star Hill, Inyo County	4,911
1215	Lookout Hill, Inyo County	4,214
1216	Malakoff, Nevada County	3,173
1217	Manzanita Hill, summit, Nevada County	3,054
1218	Marble Valley, El Dorado County	925
1219	Michigan Bar, Sacramento County	227
1220	Michigan Bluffs, Placer County	3,491
1221	Mohawk Valley, Knott's Ranch, Plumas County	4,325
1222	Monte Christo	5,056
1223	Montezuma Hill, Nevada County	2,853
1224	Mooney Flat Hill Summit, Yuba County	1,170
1225	Moore's Flat, Nevada County	4,231
1226	Morris Ravine, Butte County	524
1227	Mud Springs, El Dorado County	1,658
1228	Needle Peak, Inyo County	7,086
1229	Newtown, El Dorado County	2,482
1230	Nichols' House, Cave City, Calaveras County	1,593
1231	Nine-Mile Station, Inyo County	2,510
1232	North Bloomfield, Nevada County	3,278
1233	Nuevo, San Diego County	1,200
1234	Oliver Mountain Summit, El Dorado County	3,221
1235	Omega, Nevada County	4,201

TABLE OF ALTITUDES—Continued.

No.	Station.	Elevation. Feet.
1236	Onion Valley, Plumas County	6,160
1237	Ophir Mountain, Inyo County	6,063
1238	Oro Flat, Placer County	2,842
1239	Oroville, Butte County	375
1240	Pilot Hill (Summit), El Dorado County	1,857
1241	Pinto Peak, Inyo County	7,267
1242	Plugugly Hill (Summit), Placer County	3,251
1243	Pluto Summit, Placer County	8,633
1244	Post Office Spring, Inyo County	1,294
1245	Prospect Flat, El Dorado County	2,214
1246	Puckerville, Amador County	1,037
1247	Quaker Hill, Nevada County	3,265
1248	Reeds, Yuba County	433
1249	Rice's Bar, Placer County	1,184
1250	Rough and Ready, Nevada County	1,901
1251	Sailor Cañon, Placer County	5,251
1252	Sailor Flat, Nevada County	3,050
1253	St. Helena Mountain, Napa County	4,343
1254	St. Helena Mountain, Napa County, first bench above Toll House	3,825
1255	Salt Spring, Death Valley, Inyo County	—63.9
1256	San Bernardino Hot Springs	1,600
1257	San Juan, Nevada County	2,143
1258	Santa Barbara Hot Sulphur Springs	1,500
1259	Santa Ysabelle Valley, San Diego County	2,700
1260	Sebastopol, Nevada County	1,893
1261	Secret Hill, Summit, Placer County	6,536
1262	Secret House, Placer County	5,423
1263	Sentinel Peak, Inyo County	9,850
1264	Sheep Ranch, Calaveras County	2,273
1265	Sierra City, Sierra County	4,188
1266	Smartsville, Yuba County	758
1267	Smartsville Hill, summit, Yuba County	1,074
1268	Snowy Mountain, Placer County, summit	8,425
1269	Soda Springs, Shasta County	2,363
1270	South Yuba Bridge	420
1271	Spanish Dry Diggings, El Dorado County	2,158
1272	Squaw Valley, Placer County	6,304
1273	Steep Hollow, Nevada County	3,342
1274	Sucker Flat, Placer County	670
1275	Summit, Soda Springs, Placer County	6,009
1276	Sugar Loaf, Butte County, summit	1,647
1277	Sugar Pine Pass, Placer County	7,130
1278	Surprise Cañon, Inyo County	2,650
1279	Sutter Creek, Amador County	1,197
1280	Table Hills east of Owen's Lake, Inyo County	7,343
1281	Table Mountain, Tuolumne County, summit	2,214
1282	Three Prong, Placer County, summit	9,000
1283	Timbuctoo, Yuba County	441
1284	Timbuctoo Mountain, Yuba County	917
1285	Todds Valley, Placer County	2,750
1286	Toll House, St. Helena Mountain, Napa County	2,300
1287	Tucker's Ranch, Plumas County	4,100
1288	Tuscan Springs, Tehama County	600
1289	Volcanoville, El Dorado County	3,081
1290	Water Station, Inyo County	2,110
1291	Webber Hill, El Dorado County, summit	2,184
1292	Whitesel's Ranch, Nevada County	1,686
1293	Wilcox Meadows, El Dorado County	5,344
1294	Wilcox Ravine, Nevada County	2,799
1295	Windy Gap, Inyo County	2,053
1296	Wisconsin Hill, Placer County	2,936
1297	Wilks' Ranch, El Dorado County	3,386

WATER POWER.

In a State like California, in which a large portion of the area is much above sea level, and where there are a multitude of streams, large and small, flowing from the high lands, there must be and are many localities where water power is abundant and available. This very important matter is just beginning to attract attention in California. At Grass Valley, in Nevada County, where gold mining has been the principal business and the support of the people, up to a recent date, steam was almost universally used to drive the quartz mills. But in 1882 the Idaho Company, although possessing the best quartz mine in the State, began to consider the advantage that would be derived from the substitution of water for steam power. They began to buy water from the South Yuba Canal Company, and after an experimental working for a year, found the annual saving over steam to be from $25,000 to $30,000. There are many localities in the mountains and foothills of California where may be found gold quartz veins, water power, and fertile hillside and mountain valley lands. This Piedmont region will support a large population, and is really the most beautiful part of the State. Mines that would hardly pay if steam power was employed, with cheap or free water power, all the operations of mining and milling may be performed, with but few hands. The same water that serves the mill will hoist the ore, pump, force air into the mine for ventilation and power drilling. Almost any quartz vein in California could be made to pay under these circumstances, and the application of this cheap power would add much to the prosperity of the State.

It will soon again be cheaper to move manufactured articles from water power to a market than to make them by steam elsewhere. Water is equally useful for irrigation and mining purposes after being used for water power, as long as it is not allowed to fall below a certain altitude.

IRRIGATION.

Soon after the first excitement caused by the discovery of gold in California began to subside, attention was turned in a limited way to the agricultural resources of the State. It was first supposed—from the peculiar dryness of the summer months, during which rain seldom falls—that the country would never be an agricultural one in any general sense, but this theory was disproved by experience. At the same time it became evident that a different system of culture, suited to the climatic periods of excessive moisture alternating with equally excessive dryness, must be pursued. Experiment led to the adoption of a system of irrigation.

When the new method began to be understood, and intelligently carried out, it was found that most extraordinary crops were the result.

The dry valley lands of Fresno, San Bernardino, Kern, and other southern counties where water has been introduced, are found to be unusually fertile, and beautiful and prosperous settlements have sprung up in what was at first thought to be a desert. The subject of irrigation and the use of the waters of the State for other purposes than navigation, has grown in importance until it is admitted to be the most momentous question now before the people. The rights of riparian owners have been questioned and much useless legislation has been enacted without arriving at any satisfactory conclusion. The debris or mining question goes hand in hand with irrigation, and though seemingly different, is in fact only another phase of the same important subject. Judging from the trouble the ancients had with this same question, it will not be settled in California for some time to

come. The proper and just distribution of the surplus waters of the State, and the extraction of the vast deposits of gold known to exist in the foothills, are matters which have an important bearing on our material interests. To solve this problem, and protect the conflicting interests of those concerned, is work for future legislators, and the more the matter is agitated now, the sooner will a settlement be effected.

In some localities where it is difficult to obtain water from living streams, artesian wells are being sunk, and very successfully. From these wells, in some parts of the State, natural gas escapes in considerable quantities, giving hope that gas-wells similar to those now attracting so much attention in Pennsylvania may yet be discovered. A notable example of this at the present time is at the city of Los Angeles, where a vein of gas was struck in sinking a well. The gas became ignited from a cigarette, and blazed up to a height of ten feet. An article in the Los Angeles *Herald* assumes that a dozen wells sunk within the city limits would each of them yield gas which might be utilized.

The city of Stockton is supplied with water from artesian wells, some, if not all, of which also produce gas as well as water. The wells sunk for oil in various parts of the State, in perhaps a majority of cases, produce gas. This is a subject worthy the attention of scientific and practical men. May not these emanations of gas indicate vast bodies of coal, which we may at any day discover by sinking wells in search of water?

The State Mining Bureau should employ special persons to study and investigate these matters, and preserve in the State Museum sections of the various wells, which would enlarge our information as to the geology of the valleys, and throw light upon their origin.

Mr. George A. Raymond, more thoughtful than most persons engaged in the business of sinking artesian wells, has carefully preserved specimens of borings, and kept a register of the findings. This should be done officially by the State Mineralogist, and all the results published as frequently as possible, in the general interest. Mr. Raymond has donated to the State Museum samples of borings which are specially interesting. The following are copies of these tabulated records, exactly as kept by him on printed blanks.

RECORD OF STRATA IN ARTESIAN WELL

Drilled by Geo. A. Raymond for J. B. Haggin, Kern County, on Sec. 30, T. 29 S., R. 25 E., Mount Diablo Base and Meridian. Screw Casing 5 5-8 inches diameter.

Depth—Feet.	Thickness—Feet.	Character.	Remarks.
12	12	Black clayey soil	
14	2	Sand	Surface water.
24	10	Yellow clay	
27	3	Sand	
49	22	Yellow clay	
57	8	Sand	
68	11	Brown clay	
80	12	Sand	
82	2	Hard pan	
130	48	Sand	
152	22	Clay and cement	
155	3	Hard pan	
185	30	Sand	
191	6	Cement	
193	2	Yellow clay	
220	27	Sand	
225	5	Yellow clay	
245	20	Sand, cement, and hard pan	In streaks very hard.
255	10	Yellow clay	
272	17	Sand and cement	
285	13	White clay	Like potters' clay.
287	2	Sand	
297	10	White clay	Like potters' clay.
330	33	Sand	
342	12	Hard pan	Very hard.
387	45	Sand	
395	8	Hard pan	Very hard.
403	8	Sand	
433	30	Hard pan and clay	Very hard streaks.
455	22	Hard pan and cement	Very hard streaks.
463	8	Sand	
475	12	Yellow clay	
493	18	Sand and gravel	
530	37	Hard pan and sand	Very hard streaks.
542	12	Sand	
602	60	Hard pan, clay, gravel, and cement	*Streaks very hard—water.
608	6	Yellow clay	
630	22	Hard pan, clay, gravel, and cement	Streaks very hard—water.
642	12	Sand	
648	6	Yellow clay	
650	2	Sand	

Stopped work for the present May 20, 1886.
* Water rose to within seven feet of surface.
No flow at above depth.
This well will be carried deeper within a few months. Say about August or September, 1886.

RECORD OF STRATA IN ARTESIAN WELL

Drilled by Geo. A. Raymond for J. B. Haggin, in Kern County, on Sections 29, 30, 31, 32, T. 30 S., R. 26 E., Mount Diablo Base and Meridian. Screw Casing 5 5-8 inches diameter.

Depth—Feet.	Thickness—Feet.	Character.	Remarks.
4	4	Dry sandy soil	
96	92	Quicksand	*First surface water.
98	2	Yellow clay	*No toughness or strength.
280	182	Quicksand and gravel	*Small streaks cement of no strength.
283	3	Blue clay	
340	57	Quicksand and gravel	†Small streaks cement and hard balls.
344	4	Blue clay	
374	30	Quicksand and gravel	†Hard balls.
376	2	Blue clay	
412	36	Sand and gravel	Hard streaks cement.
421	9	Blue clay	
432	11	Quicksand	
440	8	Blue clay	
460	20	Quicksand	Small flow water.
464	4	Blue clay	
472	8	Sand	Second flow water.
----	-----	Blue clay	Bottom of casing in blue clay.

Sufficient flow of water for two thousand head of stock.
*Equivalent to 280 feet of continuous quicksand, as the yellow clay was so thin and frail that it would not hold up the weight of the quicksand above.
†Samples of hard balls given to Mr. Hanks.
Well completed March 15, 1886.

Some of the specimens taken from the wells, I have examined microscopically and otherwise, and found exceedingly interesting, but to publish an account of them in their present unfinished condition would be premature.

MINERAL SPRINGS IN CALIFORNIA.

Numerous mineral springs are known to exist in California, some of which have gained celebrity, others are nameless and are only known by their localities. Some of the latter may eventually prove to be of great value. From the fact that it has been impossible to maintain a chemical laboratory in connection with the Mining Bureau, the official guide-book which was planned has not been made, and it has not been possible even to visit the most noted springs to study and publish their characteristics. The State Mineralogist has only been able to gather such information as could be easily obtained, and to condense it into the following list.

Among the many mineral products of the State the numerous mineral springs are not the least important. In Germany, Italy, Switzerland, England, France, Spain, Austria, Scotland, Ireland, Bohemia, and Portugal, in Europe, and New York, Virginia, Arkansas, Pennsylvania, West Virginia, Wisconsin, Kentucky, Ohio, Mississippi, Michigan, and Alabama, in the United States, and in Canada and elsewhere in the world, mineral springs are found. Mineral waters are generally divided into two principal groups—hot and cold. The principal subdivisions are—

Salt waters.	Alkaline waters.
Iron waters.	Mud springs.
Sulphur waters.	Alkaline saline.
Lime waters.	Magnesian.

A few more or less celebrated springs contain notable quantities of some special mineral or salt, to which they owe their peculiar character, as iodine, bromine, lithium, or fluorine.

California abounds in mineral springs more or less celebrated, but there seems to be no system in the use of the waters. People go to any spring which suits their taste or convenience, without knowing or seeming to care for the effect the water will have on them. This results from the fact that but few reliable analyses have been made, and physicians are at a loss how to prescribe for that reason. There should be an official guide book made by the State Mineralogist, which would be of very great utility to the State.

Such a work would necessitate the establishment and maintenance of a very complete chemical laboratory, and the employment of able assistants. The following are the most important known mineral springs in the State. There are many others of less note, but which may be of equal and possibly greater value and importance. The late Dr. Hatch published the best account and description of the mineral waters of California, that has been previously written.

Alameda County.

(1) *Piedmont Springs.*

Situated three miles from Oakland. As far as I am aware, no analysis has ever been made of the water of these springs, although they have attained considable celebrity.

Calaveras County.

(2) *Lane's Mineral Springs.*

These springs are located in the foothills of the Sierra Nevada, at an altitude of one thousand feet above sea level. They lie thirty-five miles east

of Stockton, from which place they may be reached by stage on alternate days; visitors are accommodated at a good hotel, besides which there are cottages for those who prefer them. The water in the springs is clear and cold, but no other information has been obtained, nor has any analysis been published as far as I know.

Colusa County.

(3) *Simmon's Hot Sulphur Spring.*

This spring is situated in Sulphur Cañon, but the exact locality is not given. The water has a temperature of 170°, but no analysis has been received.

(4) *Wilbur Hot Sulphur Springs.*

The route to these springs is by rail to Williams, and thence by stage. An analysis by an unnamed chemist has been published. It is claimed that the waters possess curative properties specially applicable to the treatment of rheumatism and cutaneous diseases.

Contra Costa County.

(5) *Byron Springs.*

There are said to be a number of springs at this locality, some of which are hot, while others are cold, some charged with carbonic acid gas, some with sulphuretted hydrogen. They are situated very near to Byron Station. There is a good hotel at the springs, and the accommodations are said to be first class. Trains leave San Francisco at 9 A. M. and 3 P. M., and Byron at 6:30 and 9:30 A. M. I have no reliable information as to the water of these springs, nor am I aware of any analysis having been made.

Humboldt County.

(6) *A very remarkable mineral water*

Has been discovered in a nameless spring in the town of Eureka. The water issues from the bank at the edge of the bay. At high tide the waters of the bay rise and cover the spring. The Indians knew of this spring and ascribed to it remarkable curative powers. It was rediscovered accidentally by a workman while the steamer Humboldt was being built near by. The water is now used in Eureka and San Francisco.

The following analysis, not before published, reveals the remarkable character of this water:

San Francisco, May 8, 1885.

Mineral water—one U. S. gallon.

Sodium chloride	1403. grains.
Magnesium sulphate	211.3 grains.
Magnesium chloride	101. grains.
Calcium sulphate	42.5 grains.
Sodium bromide	14. grains.
Potassium sulphate	12.2 grains.
Sodium carbonate	10.1 grains.
Calcium carbonate	3.8 grains.
Alumina	1.3 grains.
Silica	.95 grains.
Carbonate of iron	.12 grains.
Manganese	Traces.
Boracic acid	Traces.
Iodine	Traces.
Lithium	Traces.

Contains a little carbonic acid, and is saturated with sulphuretted hydrogen. It is a sulphur, saline water, and should prove beneficial in affections of the glandular and lymphatic system, rheumatism, and diseases of the skin.

W. D. JOHNSON, M.D.

(7) *Felt's Springs.*

The following from the *Humboldt County Standard* contains all the information I have been able to obtain concerning these springs:

FELT'S SPRINGS.

Situated about twenty-five miles from Eureka, near the head of Strongs' Valley. Dr. Felt of Hydesville, the fortunate proprietor of these notable mineral waters, must eventually realize a handsome sum for his property. Some years ago he built a good private road from the public highway to the springs, laid pipe, concentrated the waters, cleared off some ten acres of the dense forest surrounding the springs, and erected on the opening a comfortable hotel, large barn, and other necessary improvements. The place was resorted to by many people, some for pleasure, others hoping to be benefited by drinking the mineral water, which it was well known possessed medicinal virtues of a high order. From the springs and thereabouts exudes a species of gas, which Dr. Felt collected in a primitive gasometer and utilized for the purpose of illuminating the premises, and it answered this end well. The waters have been found to be beneficial for persons afflicted with or having dropsical tendencies, many being entirely relieved who were affected in this way. About the time these springs were beginning to be appreciated on their merits, an unfortunate conflagration swept off the improvements. Since the fire the place has remained unoccupied as a public resort. We apprehend, however, upon the completion of the Eureka and Eel River Railroad, the present year (which passes within a short distance of the springs), they will again be opened for patronage.

ANALYSIS OF THE WATER.

From an analysis, made in San Francisco of a quantity of the water of Felt's Springs, it was found to contain the following substances: Carbonate of soda, carbonate of lime, a trace of iron, chloride of potassium, chloride of magnesium, carbonate of magnesia, carbonate of manganese, sulphate of potassa, and chloride of sodium. The location of this property is very picturesque, and its climate cannot be surpassed for salubrity, and with railroad communication it will make a delightful resort for the pleasure seeker as well as the invalid. There are plenty of trout in the streams and game in the woods and valleys.

Inyo County.

(8) *Owens' Lake.*

While the water of Owens' Lake is a mineral water in every sense of the word, yet it is not a mineral spring. It results from the evaporation of the water brought down by Owens' River, which enters the valley pure, but takes up in its long passage to the lake, soluble matter from the soil.

The mineral matter in solution in the waters of the river and lake is augmented by small salt and alkaline streams and the seepage from a multitude of mineral springs which abound in the foothills of the Sierra Nevada and the Inyo Mountains. The waters so extensively sold and advertised on the Pacific Coast and elsewhere under the trade name of "*Castalian*" is taken from this lake. The engraving on the circulars of this company is a deception, as it shows an imaginary spring on an isolated hill or mountain, from which a small stream is figured flowing down to the plain. The circulars claim that it is a natural mineral water from the Castalian Spring, Inyo County, which it is not. Owens' Lake is one of the most remarkable sheets of water in the world, and it is well worthy of a visit by tourists and Californians. Descriptions have been given of it in previous reports of this office. The waters are highly alkaline, remarkably dense, and in effect a nearly saturated solution of valuable salts, which will certainly be turned to account in the near future.

The waters of this lake have been analyzed by several chemists; a very full one by Thomas Price of San Francisco is published on the circulars

of the Castalian Company. The following is an approximate analysis by a London chemist by the name of Philips:

	Grains in an Imperial Gallon.
Chloride of sodium	2,942.15
Sulphate of soda	956.80
Carbonate of soda	2,914.43
Sulphate of potash	35.74
Silicate of potash	139.54
Organic matter	16.94
Pure water	2,994.40
	10,000.00

Owens' Lake may be reached by rail from San Francisco or Reno to Keeler Station, which is the present terminus of the road. The town is situated on the eastern shore of the lake.

(9) *Thermal Acid Springs.*

All the information this office has of these springs is contained in the following extract from the *Inyo Independent*, June 20, 1883:

These singular springs are situated in Inyo County, in the Coso Range of mountains, about sixteen miles southeast of Olancha Post Office. The springs have but a limited flow, and from crevices on the mountain side, through which steam is continually ejected, and thousands of tons of pure sulphur cover and surround the locality. The taste of the water is intensely sour, making it unfit for drinking purposes. It has no smell, but formerly there must have been large quantities of sulphureted hydrogen contained in it, as the sulphur deposit indicates. Large quantities of free sulphuric acid is found in the water, but the sulphur deposit, it is claimed by chemists, cannot be derived from this source. Chemists are at least unacquainted with a process by which free sulphuric acid would turn under the circumstances, such as the above, into sulphur. The composition is certainly a remarkable one, as will be seen from the following analysis. In one hundred thousand parts are contained parts:

Free sulphuric acid	78.4
Potassium sulphate	2.5
Sodium sulphate	15.1
Calcium sulphate	15.3
Magnesium sulphate	1.2
Aluminium persulphate	127.0
Iron persulphate	33.2
Nitric acid	Trace.
Chlorine	Trace.
Ammonia	Trace.
Lithium	Trace.

Springs or lakes of a chemical character like this are very rare; singular is also the small trace of chlorides in a water so strongly charged with mineral matters. The only known instance analogous to it is the Sour Lake in Texas, and a spring in the vicinity of the volcanoes in South American Cordilleros de los Andes.

Lake County.

(10) *Adams Springs.*

These springs are located in the pine mountains of Lake County, about eight miles south of Clear Lake, and two and a half miles from Siegler Springs, six miles from Harbin Springs, and twenty-eight miles from Calistoga. They are reached from San Francisco by rail to Calistoga, and thence by stage on alternate days. There is a good hotel at the springs. An analysis of the waters has been made, but the name of the chemist is unknown to me. The water is highly charged with carbonic acid gas, and is said to have a decided taste of petroleum. The waters are said to be good for rheumatism, and bilious diseases, and several cases of Bright's disease are said to have been improved by its use.

(11) *Allen Springs,*

Are located in a cañon near the head of Cache Creek, forty-five miles from Williams, which may be reached by rail from Sacramento. Communication between Williams and the springs is made by stage.

The waters of Allen Springs are cold, saline, highly charged with free carbonic acid gas, temperature 50°. An analysis made by W. T. Wenzell, whose name is a guarantee of its correctness, has been published.

(12) *Anderson's Springs.*

The character of these springs is hot sulphur and steam. They lie nineteen miles from Calistoga, and five miles from Middletown. There is a good hotel at the locality and a number of commodious cottages. No chemical analysis has been reported, and no further information obtained.

(13) *Bartlett Springs.*

These springs lie sixteen miles northeast of Clear Lake, in Lake county, and forty miles west of Williams, in Colusa county. They may be reached from San Francisco by rail to Calistoga, thence by stage. While no analysis has been published, the water is said to contain arsenic, by which reputed skin and other diseases are said to have been cured. The water is cold. It is largely bottled, and sold in San Francisco and elsewhere.

(14) *Bonanza Springs.*

There are several of these springs, about which, however, but little is known, aside from the fact that they are warm chalybeate; one is cold. There is also a cold plunge bath. No analysis has been made. Route from San Francisco is by rail to Calistoga, thence by stage to the springs.

(15) *Highland Springs.*

Situated twenty-five miles from Cloverdale, seven miles south of Lakeport, and four miles from Kelseyville, in sight of Clear Lake. Altitude, seventeen hundred feet. The springs are reached from San Francisco in ten hours by rail and steam to Cloverdale, thence by stage. There are several of the springs known by different names, as the "magnesia spring," the "magic spring," the "Dutch spring," and the "soda spring." The general character of the water may be learned by the following analysis:

Magic Springs, analyzed by Professor W. S. Rising, University of California. Temperature, 85°.

	Grains per U. S. Gal.
Chloride of sodium	1.290
Bicarbonate of potash	0.544
Bicarbonate of soda	21.763
Bicarbonate of lime	50.411
Bicarbonate of magnesia	70.243
Bicarbonate of iron	0.973
Bicarbonate of manganese	Trace.
Silica	7.398
Alumina	0.169
Organic matter	Trace.
Free carbonic acid	74.462
Total	227.253

Berkeley, April 3, 1882.

The water from these springs has been bottled and sold in the State and elsewhere to a considerable extent.

(16) *Hot Borate and Ammonia Spring.*

This remarkable mineral spring is situated on the edge of Clear Lake near the Sulphur Bank Quicksilver Mine. An analysis made by Gideon E. Moore may be found in Geology of California, vol. 1, by J. D. Whitney, folio. The water is remarkable as containing large quantities of potassium, ammonia, bromine, and borax. The waters have been used medicinally, but as yet to no great extent.

(17) *Hough's Mineral Spring.*

This spring, of which but little is known, is reached by stage from Williams in Colusa County, by which daily communication is made.

(18) *Howard Springs.*

Located five miles from Adams' Springs, one and one half miles from Siegler Springs, and five miles north of Harbin. Altitude, two thousand two hundred and twenty-five feet. May be reached from San Francisco by Napa Valley Railroad to Calistoga, thence by stage. There is a good hotel at the springs, and commodious cottages. There are said to be fourteen springs, hot and cold; temperature from 58° to 109°. One spring is chalybeate, one is cold, sparkling, and highly charged with carbonic acid gas. No analysis reported. Information as to the character of the water of this spring to be obtained without an actual visit to the locality is meager and unsatisfactory.

(19) *Iodine Spring.*

In April, 1872, a remarkable mineral water was examined by Falkenau & Hanks of San Francisco, which was found to contain considerable iodine. Information has since been obtained to the effect that the spring is situated at the entrance of Grizzly Cañon, Lake County, five or six miles from Wilbur Springs. This subject has been alluded to in the fourth annual report of this office, folio 230.

(20) *Saratoga Springs—formerly Pierson's.*

Situated fourteen miles from Lakeport, one mile west of Witter Springs. They may be reached from San Francisco by rail to Calistoga, thence by stage to Lakeport and the springs. There is a good hotel and accommodations. The springs, of which there are several, are cold. The waters are sulphurous and alkaline, containing, it is claimed, sulphur, soda, iron, magnesia, and free carbonic acid gas. No analysis is reported. It is claimed that a multitude of diseases are cured or ameliorated by the use of the waters.

(21) *Siegler Springs (hot and cold).*

These somewht celebrated springs are situated in a cañon, said to have an elevation of two thousand five hundred feet. There is at the locality a good hotel and accommodations. The waters are alkaline and chalybeate. One spring is said to contain arsenic, and to be valuable for the

treatment of chronic cutaneous diseases. An analysis of the waters is reported, but as far as can be learned it has not been published.

These springs are reached by stage from Calistoga. Time from San Francisco, twelve hours.

(22) *Witter Springs.*

These springs are situated in the Coast Range of mountains, five miles from the town of Upper Lake, and fifteen from Lakeport, near the Blue Lakes. There are several springs which are cold. They are alkaline, sulphurous, and have considerable reputation as yielding healing waters. There is a good hotel on the grounds, and a number of commodious cottages for visitors. No analysis has been published.

Lassen County.

(23) *Big Hot Springs.*

This spring lies about three miles north of Honey Lake. The exact locality is section twenty-three, township twenty-nine north, range fifteen east, Mt. Diablo meridian. It is called a boiling spring, which it practically is, its temperature being 200° F. The water rises with considerable force from an orifice equal to a foot square. From observations made by John Pfeninger, from a spout 4x18 inches, forty-five cubic inches flowed in one minute. The chemical character of the water is not known, as no analysis has been made. No medicinal properties are yet claimed for it.

Los Angeles County.

(24) *Fulton's Sulphur Wells.*

These artificial flowing wells yielding a mineral water claimed to be valuable, lie two miles north of Norwalk Station, on the Los Angeles and Anaheim railroad. An analysis is published in a circular issued by Dr. J. E. Fulton, from whom the wells are named. This shows the water to contain bi-carbonate of soda, lime, magnesia and iron, sulphate of soda, chloride of sodium, silica, traces of iodine and potash, and free carbonic acid, hydrosulphuric and nitrogen gases. The water flows from two wells three hundred to three hundred and fifty feet deep. The water is cold. There is a good hotel on the grounds, and good accommodations for visitors. A daily stage connects with the railroad at Norwalk.

Mendocino County.

(25) *California Seltzer Spring.*

This valuable spring I visited personally, and the following is the result of my observations. Analysis have been made and published by J. A. Bauer, Louis Falkenau, and by myself:

The spring is situated in Mendocino County, about one and one half miles from the Fountain House, which is twelve miles from Cloverdale, on the Ukiah road.

The distance from Cloverdale to the spring in a direct line is nine miles, and the direction, north forty-two degrees west.

The exact location may be stated as follows: It is on the southeast quarter of the northeast quarter of section five, township twelve north, range eleven west, Mount Diablo base and meridian.

The spring lies in a beautiful and picturesque valley, and the mountain scenery surrounding it is charming. A small frame building has been erected over the spring to protect it from the sun and rain. The water flows from a half-inch pipe, and I am informed by those who reside near the spring that the flow is continuous and equal throughout the

year. By careful experiment I found the discharge from the pipe to equal 45.89 wine gallons per hour, or 1101.36 gallons in twenty-four hours.

There are several points in the cañon where the same water issues from the ground, which is allowed to run to waste, all of which could be saved and turned to account.

When drawn from the spout, the water is cold, having a temperature of 61° Fahrenheit. At the time the temperature was taken that of the room was 98°.

The water, to the taste, is very agreeable. It contains such an excess of carbonic acid that that gas is continually being given off, like champagne. Carbonic acid gas is also continually bubbling up from the pool into which the water falls from the spout.

When first drawn the water is perfectly clear, but soon assumes a faint opalescence, and after standing for some time it lets fall an inconsiderable precipitate. At the exit there is a large deposit of a red sediment, which is seen on the sides of cisterns into which the water flows, and also on the stones in the bed of the stream.

The water does not act on all persons drinking it alike. To some it is a gentle cathartic, while others are not so affected.

When the water is shaken in a vessel there is a sudden evolution of free carbonic acid gas. When first drawn the water gives an acid reaction, owing to the carbonic acid: but after standing for some time, or after boiling, it becomes alkaline.

A large proportion of the solid constituents are held in solution by the free carbonic acid; these become insoluble, and precipitate, when the water is boiled.

The total solid constituents of the water in a wine gallon, obtained by evaporating that quantity of the water to dryness in a silver dish, was found to be 181.2311 grains.

Mono County.

(26) *Mono Lake.*

A wide spreading sheet of mineral water lies in Mono County, and is one among the many natural curiosities of our noble State, which should be more generally visited by tourists, which is now no hardship, as a first class narrow gauge railway runs within a short distance from its shores. This lake, which is more correctly an inland sea, resembles in many of its features the Dead Sea of the Holy Land. The same may be said of Owens' Lake, a description of which will be found in its proper place.

Mono Lake lies in a depression, in an extensive desert basin, which was probably in ancient times an extensive volcanic crater, and from which can be traced streams of ancient lava, which flowed in several directions.

The lake is fourteen miles, more or less, from east to west, and nine from north to south, but it varies in size, owing to temperature and the quantity of snow that falls during any year on the summits of the adjacent Sierras. When an unusually large quantity of snow falls the waters expand, and for the same reason they become more dilute. When the conditions are different the waters of the lake evaporate, and it shrinks. The waters becoming in proportion more dense and highly charged with salts, this fluctuation is marked on the shore by an amphitheater of low terraces.

At one time the lake was much larger than at present, as shown by magnificent terraces at a greater distance from the shores. The water derives its salts from rivers or creeks that flow into it. These collect from the volcanic soils the soluble parts, which they deposit in the lake. Having no outlet, the basin retains it, and by evaporation it becomes condensed. During a period of probably many centuries this lake has stored up vast quantities of valuable salts, which await the hand of man to gather and utilize.

These waters are intensely saline, but their exact constituents are not yet known: a careful and exhaustive analysis has been commenced by the Mining Bureau, the results of which will, no doubt, be duly published.

There are several islands in the lake, on one of which there are hot and mineral springs, a feeble remnant of the volcanic activity of former days. A few miles from the margin of the lake, may be seen several volcanic cones, expired years ago, but which have left lava and obsidian as a

memento of past volcanic energy. Great quantities of gulls and other aquatic birds flock to the shores of the lake to feast on the larvæ which abound in its waters.

The presence of worms and minute and curious living forms in the highly alkaline waters of the lake, is a striking example of nature's care for animal life. How these creatures can live in a solution so alkaline that it will attack the flesh of a human being, is one of the mysteries of the universe.

The water sent down to the Mining Bureau has been placed in a large vessel of crystal glass, and is now on exhibition in the Museum. When first received, on looking through it, one could see a number of strange animals swimming about in full possession of life and happiness; although preferring to swim on their backs, their motion resembled that of the oars of a Venetian gondola, or of the argo, as described in mythological fable. Yet, when the bottle is gently shaken, the water strikes against the sides of the vessel containing it like oil, or concentrated sulphuric acid. When evaporated this extraordinary water leaves behind a white saline mass equal to 2926 grains in an imperial gallon.

There is in my mind no finer view in the State than of the valley or desert in which Mono Lake lies, with the White Mountains for a background, as seen from the summit of Mono Pass. It is only a short distance from the Yosemite, which is visited by thousands of tourists annually. The route is by Lake Tenaya, Cathedral Peak, Tuolumne Valley, the Soda Springs, and the most romantic and highly interesting Mono Pass and Bloody Cañon. It is strange that more tourists do not avail themselves of the opportunity to visit these interesting localities.

The larvæ in the lake are thrown up by the sluggish waves, and accumulate in enormous quantities. They are gathered by the Indians and dried for food. To them they are as delightful a refection as locusts and wild honey of Bible fame.

The mineral salts contained in this vast depository should and will be utilized at no distant day. The reaction for boracic acid is so decided that it is almost safe to predict that crystals of borax will eventually be found in the mud at the bottom of the lake, as at Borax Lake, in Lake County, and it is to the interest of the State that an exhaustive analysis should be made of the waters.

The following analysis of Mono Lake water, by J. R. Murphy, was copied into the *Mining and Scientific Press*, vol. 12, fol. 59, from the *Reese River Reveille:*

Acids Present.

Quantitative.

Boracic	Large traces.
Carbonic	Abundant (free?).
Hydrosulphuric	Abundant (free?).
Phosphoric	Traces.
Silica	Traces.

Quantitative.

Chloride of sodium		5.854.
Chloride of potassium		1.581.
Chloride of calcium		2.630.
Chloride of magnesium		8.206.
Sulphate of lime		.402.
Sulphide of calcium	Traces.	
Sulphide of magnesium	Traces.	
Water		81.327.
Total		100.000.

Nameless Mineral Spring.

Near Bridgeport. This spring, represented in State Museum by No. 1,576, has deposited a very large quantity of aragonite or calcite.

MONTEREY COUNTY.

(27) *Paraiso Hot and Cold Mineral Springs.*

These springs are situated six miles from Soledad, one hundred and forty-three miles from San Francisco, on the Southern Pacific Railroad; a stage connects daily with the station. There is a good hotel on the grounds and twenty-five two-story cottages. The altitude is said to be 1,200 feet above the valley. The waters flow from a number of springs which have the same general character, as shown in the following analysis made by a well known and reliable chemist:

CHEMICAL LABORATORY, SANTA CLARA COLLEGE, S. J.,
SANTA CLARA, CALIFORNIA, November 25, 1871.

MR. PEDRO ZAVALA: Your sample of water having been duly analyzed in our chemical laboratory, gave the following result: In one gallon of water were found—

	Grains.
Matter volatile on ignition, so called organic matter	5.25
Silica	2.62
Alumina and iron	1.60
Magnesia	Trace.
Chloride of potassium	0.35
Chloride of sodium	3.50
Sulphate of soda	35.50
Carbonate of soda	4.23
Sulphate of lime	4.32
Carbonate of lime	1.43
Total	58.80

Yours respectfully,

A. CICHI, S. J., Professor of Chemistry.

P. S.—The water contains 35.50 grains to the gallon of sulphate of soda. This sulphate of soda (written otherwise Glauber's Salt) is used universally as a cathartic.

NAPA COUNTY.

(28) *Calistoga Thermal Springs.*

These springs are in the town of Calistoga within a few minutes walk of the terminus of the Napa Valley Railroad. There are a number of them, all of which are warm; some very hot. Over the principal spring now stands a small, dilapidated, wooden building with no doors or windows. The spring from which steam escapes continually, is boxed up with boards; the box is about two feet square. The temperature of a bucket of this spring freshly dipped up when I visited it, was 196° F. by two observations, carefully taken. The temperature of the air was 86°. The water that overflows heats the surface water outside the building to 120°. The water in a small creek near by was 92°. The temperature of the old mud-bath was found to be 104°, and the spring that feeds it 148°. The plunge-bath spring was 132°, and the spring that supplies the bath house 173°. The chicken-soup spring had a temperature of 154°, and the water pumped up for baths at the Magnolia Hotel at Calistoga was 102°. The waters are used both for bathing and for drinking, but an analysis was made by J. T. Rudolph of Sacramento, and published in Dr. Hatch's report, showing that, with the exception of the rather large quantity of free hydrosulphuric acid, they contain no elements likely to give them much reputation for medicinal

virtues. But there is no locality that I know of in California where such facilities are found to make a delightful place of resort. The heat of the water, now going to waste, could be employed in manufacturing, specially for fruit drying, or conducted in pipes, would impart vitality to tropical plants. Conservatories so heated could be made to vie with the celebrated palm houses of Kew Gardens in London. Calistoga is a beautiful place, situated in a most delightful locality. With a judicious outlay of capital and labor, directed by men of taste, judgment, and ability, the grounds upon which these springs lie could be made an earthly paradise.

The springs seem to originate at the base of a conical mound or butte which rises on the grounds to an altitude of from seventy-five to eighty feet, which tends to give a landscape garden aspect to the grounds.

There are good hotels in Calistoga, and on the grounds there are a number of roomy cottages for the use of visitors; in front of each is a large palmetto tree which gives a tropical appearance to the grounds. At the time of my visit, all were deserted. The *chicken soup spring* is in no way entitled to the name. It is a trick of those interested, to take up a dipper of the water and to add pepper and salt, which, to a person of active imagination, does have somewhat the taste of soup. My experiments show that any warm water so treated has the same taste, and that it is to the pepper and salt and not to the water that the taste is due.

(29) *Ætna Springs.*

I visited these springs in September, 1881, having been at the same locality when it was being worked as a quicksilver mine, a number of years before.

These springs lie in a small depression at the northern end of Pope Valley. The exact locality is sections one and two, township nine north, and range six west, Mount Diablo meridian. The altitude is said to be one thousand feet, but by barometer it seemed to be only seven hundred and sixty feet. It is fifteen miles east of St. Helena.

There are two springs which discharge a large quantity of water; one is from the old mining shaft of the Valley Quicksilver Mine. The shaft is one hundred and twenty-five feet deep. The Valley Mine was incorporated in 1867, certificate filed May sixteenth. The company made the serious mistake of sinking the working shaft in the bed of the creek, which necessitated costly pumping apparatus, and in the winter the mine was flooded by the waters of the creek. There was also much trouble caused from emanations of carbonic acid gas in the workings. At one time considerable ore was extracted, but owing to the difficulties the yield was but small.

The springs have gained quite a reputation. The number of visitors is given below for four years:

1878	300
1879	600
1880	900
1881	1,200

A full analysis of the water was made by Edward Booth, chemist of the State Mining Bureau, which is published in the second annual report of this office, folios 10 and 11. An analysis made by A. J. Bauer was published in Dr. Hatch's report. The water is perfectly clear; at the time of my visit, the temperature was 98°, that of the air being 78°. The first taste is pleasant but peculiar, and sparkling as if containing much carbonic acid gas. Both springs deposit ferruginous matter and in the dry bed of the

stream drop an alkaline incrustation. There is a distinct alkaline smell at both springs. When shaken in a bottle gas escapes. There is also a decided smell of hydrosulphuric acid when so shaken.

In one spring large bubbles of carbonic gas rise to the surface, and in a pool in the creek bed a constant bubbling takes place.

On the grounds there is a commodious hotel, and cottages for the use of visitors. The valley is warm and dry and the mountain scenery charming.

Much is claimed for the curative properties of the waters of these springs, with what truth I am unable to say.

(30) *Harbin Springs,*

Lie twenty miles more or less from Calistoga. They are reached by stage from the station. There are numerous springs. The temperature of the principal one is 118°. The waters are sulphurous and chalybeate. No analysis has been published. The springs have a good reputation and many visitors. The accommodations are said to be good. As usual in California, cottages are provided for the convenience of those who prefer them to the hotel.

(31) *Kellogg Springs.*

They lie near Calistoga. I have no other information concerning them that is reliable.

(32) *Napa Soda Springs.*

These are the oldest and the best known of any California mineral springs. For many years the waters have been bottled and sold all over the Pacific Coast. They lie on the slope of the mountains east of Napa Valley, and seven or eight miles north of Napa City. An analysis of the waters made by Dr. L. Lansweert, in May, 1856, has been published in Dr. Hatch's report. The buildings and accommodations for visitors are the most numerous and extensive of any in the State.

(33) *White Sulphur Springs.*

These springs, which lie only two miles from the Town of St. Helena, have become a fashionable and elegant place of resort. There is a good hotel, beautiful grounds, and cottages for the use of visitors. There are nine springs, having a temperature from 65° to 89° F. Analyses of three of them, made by Professor Le Conte of the University of California, have been published in the report of Dr. Hatch. The waters are used both externally and internally.

Placer County.

(34) *Cornelian Hot Springs*

Lie on the margin of Lake Tahoe. There are several of them, hot and cold. The waters are used principally for bathing. They are said to be very efficient in the treatment of rheumatism and neuralgia. The springs are reached by railroad to Truckee, thence by stage. There is a good hotel and accommodations on the grounds. As far as I have been able to learn, no analysis has been made.

(35) *Summit Soda Springs.*

Situated twelve miles from Soda Spring Station, on the Central Pacific Railroad; thence by stage to the valley in which the springs lie. The

altitude is said to be six thousand and nine feet. The waters are alkaline, with an excess of free carbonic acid gas. An analysis, made by J. F. Rudolph of Sacramento, has been published in the report of Dr. Hatch.

San Bernardino County.

(36) *Arrowhead Hot Springs.*

Located ten miles from Colton and six miles northeast of San Bernardino. Altitude over two thousand feet. First came into notice in 1858. It is claimed that the waters and climate will cure consumption. One spring actually boils, having a temperature of 210° F. An artificial pond for bathing has been prepared, the dimensions of which are one hundred by seventy-five feet. There are mud baths, also, which are deemed of great use in cutaneous diseases. No analysis has been published.

Anti-Fat Spring.

Situated twelve miles from Temescal, on the Santa Ana River. A sample of the water was brought to the State Mining Bureau and was entered on the catalogue No. 1,577. There being no laboratory, no analysis was made. The name indicates what is claimed for the water.

(37) *San Bernardino Hot Springs.*

These waters gush out from crevices in granite. Sufficient water flows from them to raise the temperature of a small stream near by to 130° F. The water so heated is ample to constitute an efficient water power. It would not be a new thing in California to see a mill wheel turned by hot water. There is a large hot spring near Blind Springs, in Mono County, which cannot, however, be classed as a mineral spring, which actually drove a quartz mill for several years. I have seen this myself. The water was scalding hot.

The San Bernardino Hot Springs are calcareous and form a deposit or incrustation on twigs and pebbles which is snow white. The temperature is from 108° to 172° F. The altitude of the springs is said to be sixteen hundred feet. No analysis of the waters has been made.

San Diego County.

(38) *Aqua Caliente. Thermal Sulphur Springs.*

These springs are on Warner's ranch, fifty miles from San Diego. There are at least seven springs, varying in temperature from 58° to 142° F. They flow from small openings in a ravine, formerly the bed of a brook now diverted. Bubbles of sulphuretted hydrogen are continually escaping. The water, highly charged with this gas, has a pleasant acid taste. At one orifice a jet of steam issues with a hissing sound. No analysis of the waters has been made. Cures are claimed for dropsy, rheumatism, and cutaneous diseases. At last accounts these springs were in possession of a band of Indians, who let adobe huts or cottages to visitors.

There are other mineral springs in this county, near Elsinore. The following, from the San Diego *Union*, is all the information I have been able to gain:

> A wonderful little valley running through the town site, containing mineral springs of hot and cold water, sulphur, soda, white sulphur, magnesia, iron, borax, hot mud, fresh water, etc.—one hundred and eighty-six in number.

San Luis Obispo County.

(39) *Arroyo Grande Warm Springs.*

These springs are located fourteen miles south of San Luis Obispo, and fifteen miles from Port Harford, by which they are in communication by daily stage. Port Harford is reached by steamer from San Francisco. There are good accommodations to be obtained at all times. As in the case of all other mineral springs in the State, it is claimed that a large number of diseases are cured by the use of the waters.

(40) *Big Sulphur Spring.*

Of which nothing more is known, lies in section thirty-six, township thirty-two south, and range twenty-one east, M. D. M.

(41) *Bitter Water Spring.*

A spring so named is located in section four, township thirty-two south, range eighteen east. No further information has been obtained.

(42) *Black Sulphur Spring.*

Is situated in the same section.

(43) *Cameta Warm Springs.*

Lie in township twenty-nine south, range seventeen east, M. D. M. I have no other information concerning them.

(44) *Iron Mineral Spring.*

Located near the Huero-Huero Rancho, on section twenty-five, township twenty-eight south, range fourteen east, M. D. M. It is said to belong to a company, and to have much value as a curative agent.

(45) *Anonymous Mineral Spring.*

Township thirty south, range fourteen east, M. D. M. No other information obtained.

(46) *Newsom's White Sulphur Springs.*

Located fourteen miles, in a southerly direction, from the city of San Luis Obispo, and twelve miles southeasterly from Port Harford, and two miles from the Arroyo Grande stage station. This would place them near No. 39. They are within six miles of the ocean beach. Much is claimed for the medicinal virtues of these waters, and they are said to be a sure cure for nasal catarrh. There is a hotel on the ground and cottages for the use of visitors. This spring is represented in the State Museum by No. 1,572.

The five following springs, which are not yet named, are in the same neighborhood, are also represented in the State Museum. The catalogue numbers are also given:

(47)—1570—*Mineral Water.*

Spring No. 1, Cuesta Ranch, northwest quarter of the southwest quarter of section seven, township thirty south, range thirteen east, Mount Diablo meridian.

(48)—1571—*Mineral Water.*

Spring No. 2, Cuesta Ranch, northwest quarter of the southwest quarter of section seven, township thirty south, range thirteen east, Mount Diablo meridian.

(49)—1573—*Water.*

From the Arroyo Grande Warm Springs, sulphur water No. 2, Santa Manuella Rancho.

(50)—1574—*Water.*

From the Arroyo Grande Warm Springs, sulphur water No. 3, Santa Manuella Rancho.

(51)—1575—*Mineral Water.*

Arroyo Grande Warm Springs, sulphur water No. 4, Santa Manuella Rancho.

(52) *Paso Robles Thermal Sulphur Springs.*

Located twenty-three miles very nearly north of San Luis Obispo, township twenty-six south, range twelve east, Mount Diablo meridian. These springs have a widespread reputation, not only for the medicinal properties of the waters, but also for the fine climate and beautiful surroundings. They lie in a natural grove of oaks, from which the name is derived. There is a good hotel, and the best of accommodations to be had. There are several springs having a temperature of from 110° to 140° F. The waters are used for drinking and bathing. When largely used they are laxative, otherwise tonic, and are specially recommended for rheumatism, malarial affections, and cutaneous diseases. Two analyses have been published in the report of Dr. Hatch, one from a clear thermal spring and one of a mud bath. The name of the chemist is not given. The water is charged with gas. About the principal spring an inclosing wall of freestone has been built. The water is clear, but smells strongly of hydrosulphuric acid gas. The water of some of the springs is nearly cold. The mud baths are artificially prepared.

Santa Barbara County.

(53) *Santa Barbara Hot Sulphur Springs.*

Altitude, about one thousand five hundred feet. There are seven springs at the locality, nearly all of which are of the same general character. They are said to contain free sulphur (if so it must be held in suspense), and an excess of hydrosulphuric acid (sulphuretted hydrogen). Temperature, from 114° to 117° F. The waters are held in high esteem for the cure of cutaneous diseases, rheumatism, and paralysis. An artifical bath has been constructed, which is deep enough for a plunge. The springs are accessible by steamer to Santa Barbara; thence by stage. Distance, about five miles. No analysis has yet been made of the water. A thick incrustation of sulphate of alumina forms at the outlet of one of these springs.

Santa Clara County.

(54) *Gilroy Hot Sulphur Springs.*

These springs are situated twelve miles east of Gilroy, from which they may be reached by stage. There is said to be but one principal spring, located near Coyote Creek. The water is clear and hot. It is used both for bathing and drinking. There is a good hotel at the springs, which affords excellent accommodations. No analysis has been published, to my knowledge.

(55) *Alum Rock Sulphur Springs.*

Situated in Penitentiary Cañon, seven miles from San José. The character of the springs is given as sulphur, soda, and salt springs. The temperature is 85°. A partial analysis has been published in Dr. Hatch's report. There is a good hotel at the springs, and good accommodations. From San Francisco these springs may be reached by rail to San José; thence by stage.

(56) *Pacific Congress or Saratoga Springs.*

Locality in the Coast Range, ten miles west of Santa Clara. The water is quite extensively bottled and sold in the State. The springs are chalybeate and alkaline. If the water is freely used it acts as a purgative, otherwise the effect upon the system is tonic. Two analyses have been made—one by J. A. Bauer, and one by James Howden, which are published in the report of Dr. Hatch. The best of accommodations at the hotel or in cottages, according to the taste or desire of visitors. The springs may be reached by rail to Los Gatos; thence by stage.

(57) *New Almaden Vichy.*

This spring has long been known. It is situated near the New Almaden Quicksilver Mine. Many years ago the waters were largely bottled and sold. It was specially a favorite with the French population. An analysis by E. Pique, of San Francisco, was published as an advertisement by those who made a business of the sale of the water. The analysis is given below:

One bottle (two pounds) contains one hundred and eight grains and sixteen hundredths of solid matter, as follows:

Acide carbonique (carbonic acid)	28.02 grains.
Bi-carboate de soude (bi-carbonate of soda)	50.03 grains.
Bi-carbonate de chaux (bi-carbonate of lime)	8.00 grains.
Oxyde de fer (oxyd of iron)	1.02 grains.
Sulfate de chaux (sulphate of lime)	10.05 grains.
Sulfate de magnésia (sulphate of magnesia)	3.00 grains.
Chlorure de sodium (chloride of sodium)	8.04 grains.
Silice (silica)	Traces.
	108.16 grains.

It is claimed these waters possess curative properties in case of rheumatism and gout, and to be a valuable tonic. It is curious to note that an unusual number of the best mineral springs in the State are in the near vicinity of quicksilver mines.

(58) *Magnetic Mineral Spring.*

Near Watsonville; no reliable information could be obtained concerning this spring without a visit to the locality.

Shasta County.

(59) *Soda Springs.*

These springs are situated in the cañon of the Sacramento River at an elevation of two thousand three hundred and sixty-three feet. The waters are chalybeate. As they run from the springs they deposit an extensive bed of iron. There is an excess of carbonic acid gas in the waters, which are cold; temperature, 52°. They may be reached from San Francisco by rail to Redding; thence by stage. The locality and the springs are described in Geology of California (Whitney), vol. 1, folio 332.

Solano County.

(60) *Tolenas Spring.*

Situated five miles north of Suisun. The waters are saline alkaline, but in the absence of any analysis no further information can be given. The water has, to a limited extent, been charged with carbonic acid, bottled, and sold. The spring may be reached from San Francisco by rail to Suisun, and thence by stage or private conveyance.

(61) *Fairmont Mineral Spring,*

On Whitman's Ranch, four miles east of Cloverdale. No analysis has been made that I can obtain information of.

(62) *Litton Seltzer Springs.*

These justly celebrated springs are situated near Healdsburg; the waters contain carbonated alkali, and an excess of carbonic acid gas. They are pleasant to the taste, and many cures are accredited to their use. The water is largely bottled, and sold in this city and State. There is a good hotel, and first class accommodations on the grounds, which are near a railroad station. When freshly drawn, the water is slightly acid; after standing, it becomes alkaline. One wine gallon contains 228.69 grains of solid constituents, which consist of the following:

Acids.	Bases.
Boracic.	Alumina.
Carbonic.	Ammonia.
Hydrochloric.	Iron.
Sulphuric.	Lime.
Silicic.	Silica.
	Magnesia.
	Potash.
	Soda.
	And organic matter.

There is a large quantity of free carbonic acid which escapes on standing. The water in the spring is abundant. When it is required in bottles it is forced into a receiver with considerable pressure, from which it is drawn into bottles and quickly corked. No carbonic acid gas is added artificially to the water.

(63) *Geyser Spa or Geyser Soda Spring.*

This spring is situated four miles from Geyserville, and very near the Litton Springs (No. 62). Large quantities of the water is bottled and sold in the city and State. There are agencies also in Sacramento, Oakland,

Santa Rosa, and San Rafael. These waters were thus sold twenty-four years ago. The business was resumed last November. An analysis published by Dr. Hatch in his report shows the water to be very nearly identical with that of Skaggs Spring.

(64) *Mark West Hot Sulphur Spring.*

Located eight miles from Santa Rosa on the road to Cloverdale, township eight north, and range eight west, by Bancroft's map. Beside the hot spring there are cold sulphur and iron springs. No analysis of the waters have been published. There is a good hotel and cottages on the grounds which furnish first class accommodations.

(65) *Skaggs Springs.*

Located eight miles southwest of Geyserville, in township ten north, range eleven west, Mount Diablo meridian. There are two springs of hot water, and a cold soda spring. The principal spring is situated in the bed of a dry creek. The temperature is 130° to 140° F. An analysis by Professor E. W. Hilgard, of the University of California, has been published. Besides those mentioned above there is a chalybeate well. A good hotel and commodious cottages offer ample and excellent accommodations. The waters are recommended for neuralgia, rheumatism, sciatica, dyspepsia, and chronic diseases of the kidneys.

(66) *Geysers.*

The group of mineral springs known by this name, of which there are three hundred in number, covering an area of one thousand acres, are counted among the natural wonders of California. The altitude is given as one thousand nine hundred feet above sea level. Some of the springs are hot, others cold. One blows off steam like the escape pipe of a steamboat, from which it takes the name of the "Steamboat Geyser." The springs were discovered in 1847, since which they have been visited by many persons. No sufficient analysis or analyses have ever been made of the waters of these springs, nor have the waters ever been bottled for sale. The springs are situated on the Pluton River, which empties into Russian River, near Cloverdale.

There are two routes to these springs. By rail, either to Cloverdale or Calistoga, and thence by stage. There are ample hotel and bathing accommodations. The temperature of the springs, of which there are three classes—aluminous, sulphurous, and chalybeate—is from 200° to 210° F.

(67) *Santa Rosa White Sulphur Springs.*

They lie only two miles from Santa Rosa. Hot and cold sulphur baths are offered to visitors. No further information has been obtained.

TEHAMA COUNTY.

(68) *Tuscan Springs.*

Lie in section thirty-two, township twenty-eight north, range two west, nine miles from Red Bluff. There are three principal springs of *cold sulphur waters.* The water for bathing is heated by burning the carburetted hydrogen gases given off by the springs. The temperature of

three springs is thus given: Black sulphur, 68° F.; white sulphur, 70° F.; red sulphur, 80° F. The waters are said to contain large quantities of iodine, lithium, and of potash, and to be effective remedies in treatment of rheumatism, cutaneous diseases, and intermittent fevers. They are said also to resemble the Blue Lick waters of Kentucky.

(69) *Lick Spring.*

This is one of the Tuscan Springs (No. 68), which was discovered by Dr. John A. Veatch in January, 1856, in what was then Shasta County. The subject is referred to on folio 15 of Part II, third annual report of this office, 1883. An analysis was made by Dr. L. Lanszwert and published by Dr. J. B. Trask, first State Geologist, in his report of 1856, folio 61. By referring to this analysis it will be seen that it was of a most surprising nature, but Dr. Veatch states that it is unreliable. Still, the practical results obtained were very extraordinary. In January, 1856, Dr. Veatch, while evaporating the water in course of a chemical examination, obtained several pounds of borax crystals, which were deposited in the museum of the California Academy of Sciences, where they probably still remain. This was the first borax known to exist on the Pacific Coast. By a reference to the former reports of this office it will be seen how important that discovery really was.

Tuolumne County.

(70) *Cold Soda Spring.*

This very important mineral spring, which I have visited, is situated in Tuolumne Valley, on the Mono trail from the Yosemite to Mono Lake. It is located on Holt's map in township one south and range twenty-four east, M. D. M. The water is cold, sparkling, and delightful to the taste. The surroundings are charming. No analysis has, to my knowledge, been made of the water. At some not very far distant time this will become a favorite place of resort.

CALISTOGA SILVER MINES.

For many years indications of silver have been found in the vicinity of Calistoga, in Napa County. The hot springs described elsewhere are evidences of active solfatara, which elsewhere in the State have produced mineral veins of greater or less value. In the strata exposed by the upheaval of Mount St. Helena, there are veins or deposits which are without doubt the result of solfataric action. Silverado, on the mountain above the toll house, was at one time the scene of considerable mining excitement. A mill was erected and much work done on the mine. While it is claimed that considerable silver was extracted from the ores, it has never been shown by figures that this was the case. Some years ago, but after the mine was abandoned and while the mill stood idle, I examined very closely some ore left on the platform, and found it to be very poor, from which I drew the inference that work was discontinued because the ores were practically worthless.

Afterwards, in 1865, I again visited the locality and made a very careful examination of the ore on the dump and in the workings of the Venus Mine at Silverado. My impression was that as far as developed the ores

were of very low grade, but from indications ore bodies of some value might eventually be discovered. The following is the result of an assay of sample of ore from this locality:

CALIFORNIA ASSAY OFFICE, WM. IRELAN, JR., ASSAYER AND CHEMIST,
ROOMS 47, 48, AND 49 MERCHANTS' EXCHANGE, SAN FRANCISCO, September 5, 1885.

Memorandum of assay of ores made for H. G. Hanks, State Mineralogist, of ores marked "Dump, Calistoga or Venus Mine," and "Average from Calistoga—Museum No. 6,518."

Dump, Calistoga or Venus Mine.

Silver, per ton	Troy ounces, 2.18
Gold, per ton	Troy ounces, 0.03

Average from Calistoga—Museum No. 6,518.

Silver, per ton	Troy ounces, 4.37
Gold, per ton	Troy ounces, 0.15

Respectfully submitted.

WM. IRELAN, JR.

I afterwards visited the Grizzly Mine, near the town of Calistoga, and was surprised to find a considerable quantity of good ore taken out, some of which was very rich, as may be seen by the following assay of sample brought to San Francisco and placed in the State Museum:

CALIFORNIA ASSAY OFFICE, WM. IRELAN, JR., ASSAYER AND CHEMIST,
ROOMS 47, 48, AND 49, MERCHANTS' EXCHANGE, SAN FRANCISCO, August 27, 1885.

Memorandum of assay of ore made for Henry G. Hanks, Esq., State Mineralogist.

Silver, per ton	Troy ounces, 514.79
Gold, per ton	Troy ounces, 0.5

Respectfully submitted.

WM. IRELAN, JR.

This result is very remarkable, and seems to justify the hope that valuable if not extensive silver mines may yet be found at this locality. The Calistoga Mining District is situated in section twenty-four, township nine north, range seven west, M. D. M. The altitude of the Grigsby Mine is two hundred and sixty feet above Calistoga, or five hundred and ninety-one feet above sea level. The Ida Easley Mine is still higher, but in the same district. This mine is not yet worked to any great extent. It would be hard to predict what developments may yet be made at this very interesting locality.

The little hill, or butte, at the thermal springs, mentioned elsewhere, is an outlier of the mountains which contain the silver ores.

ARROW MINING DISTRICT, SAN BERNARDINO COUNTY.

A new gold and silver district has recently been brought to notice, located and named as above. The name is derived from the arrow weed springs, so called, because they furnish the Indians with rush-like stems, which grow in abundance on the margin of the springs, and which they use for the shafts of their arrows. The district lies about twenty-eight miles northwest from Fenner Station, on the A. & P. R. R.

The veins, or ledges, bear north by east, and can be traced on the surface for several miles. The principal vein is a contact, the west wall being described as porphyry, and the west quartzite, or granite.

The ore contains gold 760 fine, stained also with copper, and gives indications of silver, aside from that occurring alloyed with the gold. There were eleven locations made on the principal vein at the time of the visit of

my informant, Mr. E. Wolleb of San Francisco, who examined the district in February, 1886. The Arrow and the Red Cloud are the principal veins. But little work had been done. Water from the Arrow springs could be used for mining and milling purposes, but the excessive dryness of the locality it is feared will form a serious impediment to the working of the mines.

MOUNT ST. HELENA.

On the twenty-third of August, 1885, I started from the toll house to ascend Mount St. Helena. This station is about two thousand one hundred and thirty-seven feet above Calistoga, or about two thousand four hundred and sixty-eight feet above the sea level. There is no wagon-road, but a good trail, leading by a circuitous route up the sloping side of the mountain. The distance from the toll house to the summit is about four miles. The first bench has an approximate altitude of one thousand five hundred and seventy-five feet above the toll house, or three thousand nine hundred and ninety-three feet above the sea level. From this point, the mountain top may be seen at the distance of a mile or so. The ascent from this bench is not difficult.

Before reaching the foot of the highest peak, a depression may be seen to the left, through which a view of the valley beyond is obtained. On the right hand side of this ravine, there is a fine outcropping of basalt in distinct columns, which average about eighteen inches in diameter ; some, however, being three feet.

On the summit, the basalt occurs—the columns being broken off square and forming the extreme top of the mountain. This rock is peculiar and very interesting. It is somewhat brecciated or spotted, light colored, yellowish in places, in others a pale, undecided green ; the latter seems to have changed from olivine. On the weathered surfaces, the iron has become peroxidized, and a reddish or tawny color is the result. There seems no doubt that the character of the rock has changed, and that it is now decidedly metamorphic. Under the microscope, the crystals imbedded in the magma forming the rock, are not distinct and have lost their luster. It is much to be regretted that it has been impossible to give this rock the careful study and thorough chemical and optical examination it deserves.

The sides of the mountain near the summit are covered with a greenish colored sand, resulting from the disintegration of the basalt. Lower down, near the toll house, the lava rocks, probably basalt, are dark brown, and inclose nodules resembling stone axes. If one of these only had been found, it would not be difficult to believe that it was made by human hands. One had a groove, very roughly cut, which the finder claimed had been made by human beings previous to the flow of the lava. Before I visited the locality, having seen this one only, I was inclined to the same opinion; but finding several resembling it on the same ground, I concluded that the grooving was the work of very recent hands.

On the summit of the mountain there are two brick columns that supported scientific instruments used by the Coast Survey, which had a station there for several months. There is also a bar of copper, marking the junction of Lake, Napa, and Sonoma Counties. The summit is nearly bare of vegetation, and is covered with broken blocks of basalt.

The elevation of Mount St. Helena, as determined by the Coast Survey, is four thousand three hundred and forty-three feet; Calistoga is three hundred and thirty-one, the Toll House about two thousand four hundred and sixty-eight, and the first bench three thousand nine hundred and

VIEW OF THE SUMMIT OF MOUNT ST. HELENA FROM FIRST BENCH ABOVE TOLL HOUSE.

BASALTIC COLUMNS NEAR SUMMIT OF MOUNT ST. HELENA.

ninety-three feet. From the top of the mountain the view is very fine; on a clear day even grand. If a good grade should be made from the toll house, an easy matter, the locality would soon become a favorite place of resort.

There is reason to believe that St. Helena was once an active volcano, although the summit does not now present a crater-like appearance. That the action has not yet ceased is evinced by the hot springs at Calistoga and elsewhere, the emanations of carbonic acid in Clear Lake, especially at the remarkable spring at Soda Bay, the sulphur bank and quicksilver mines, and the ammoniacal springs near by.

June 12, 1841, this mountain was ascended by Wosnessensky, a Russian naturalist, sent out by the Academy of Science of St. Petersburg. He placed an engraved copper plate on the summit, which was removed by some vandal who found it there. It came into the possession of Dr. J. A. Veatch, who presented it to the California State Geological Survey. It would be interesting to know where it is now.

About Clear Lake there are great quantities of obsidian, from which the Indians for many years have not only made arrow and spear points, but have exported the material, or the manufactured articles, to distant tribes.

After thinking the matter over since my visit to this very interesting locality, and knowing of the evidences of recent volcanic action (recent in a geological sense only), I see no reason why the mountain may not again break out into active eruption at any time. It is not an uncommon circumstance for volcanoes to remain dormant for centuries, and then, without any special preliminary symptoms, to break out into violent eruption. Our frequent earthquakes are another evidence that the stupendous piles of eruptive matter, the result of volcanic action in centuries past, were thrown out by subterranean forces not yet extinct. Ætna remained dormant for several hundred years at a time; once, within historical period, for four hundred years; another interval was three hundred and fifty years. Vesuvius had been inactive for ages, when it suddenly burst into flames in the year 78 A. D., at which time the cities of Pompeii and Herculaneum were destroyed. It now rises only two thousand three hundred feet above the sea level; but in 1868, when augmented by the piling up of eruptive matter, its summit reached the height of four thousand two hundred and fifty-three feet—nearly that of St. Helena at present.

I would advise tourists in California to visit the hot springs of Calistoga, Clear Lake, and the summit of Mount St. Helena.

SAN DIEGO COUNTY.

Having found it convenient to visit the western part of San Diego County I am enabled to give some general information concerning it. It was my intention to commence at the Mexican line, and to have made a geological and mineralogical reconnoissance of the whole State to the northern boundary, but I was not able to carry out my plans. On several occasions during the last six years I have examined the eastern portion of this very interesting and important county, the results of which may be found in preceding reports.

I left San Francisco, May eighth, by steamer. The weather at this time of year is delightful on the coast, and a coasting voyage is always one of pleasure and interest. Passed Monterey at 4 P. M., and Point Sur, an outlying promontory, and arrived at Port Harford, San Luis Obisbo County, May ninth, at 2 A. M. Left this port at 7 A. M. and ran down by Point Sal and Conception. At 2 o'clock passed Goleta, and saw petroleum spreading over the sea, rising from submarine springs. As the ship throws aside the water in her passage, a strong smell of coal oil is observed. I had often heard of this locality and the oil springs, but I did not realize the extent of surface covered, or the signification from an economic standpoint. The smell is not of asphaltum, but of light coal oil, which to the experienced sense is distinctly different. This locality should be studied, and wells sunk at Goleta, in the hope that the source of these springs may be tapped and the oil utilized. At 3 o'clock P. M. the ship arrived at Santa Barbara, where she remained long enough to allow the passengers to see the town. I noticed a yellow or buff colored sandstone, which is now used for building purposes. It has been fully described under the head of Rocks and Building Stones. It is not very durable, which is evidenced by the decay of the Mission buildings, which are partially built of it. May tenth arrived at San Diego. In entering the harbor a striking feature is observed. The sea is covered with kelp, which, growing from the rocks beneath, spreads its flat leaves on the surface, and in time of storms is said to act like oil on the troubled waters, and to prevent the waves breaking as violently as they would otherwise do.

AREA OF SAN DIEGO COUNTY.

Assuming Bancroft's map of California, dated 1882, to be correct, San Diego County has an area of fourteen thousand four hundred and twenty-eight square miles, equal to nine million two hundred and thirty-three thousand nine hundred and twenty acres. There are eight States of the American Union that have less area than this one California county, as follows:

Rhode Island, square miles	1,306
Delaware, square miles	2,120
Connecticut, square miles	4,750
Massachusetts, square miles	7,800
New Jersey, square miles	8,320
New Hampshire, square miles	9,280
Vermont, square miles	10,212
Maryland, square miles	11,124

For seventy-five miles inland from the seacoast, the country is broken into irregular spurs and short mountain chains. The Colorado Desert

extends for about one hundred miles beyond this point to the Colorado River. The dividing ridge seems to be the San Jacinto Mountains, the highest elevation of which is eleven thousand feet. A portion of the Colorado Desert is below the sea level. The lowest depression, two hundred and sixty-two feet, is on section twelve, township ten south, and range twelve east, S. B. M., or very near that locality. The mud volcanoes lie in the northern part of section fifteen, township eleven south, and range thirteen east. This very interesting locality is fully described on folio 227 of the second annual report of the State Mineralogist, and a map of the region is also published in that volume. Beyond the basin of the dry lake the surface rises again, and is broken into isolated buttes which, from the almost total absence of water, have not been prospected, but appearances lead to the hope and expectation that valuable minerals will be found in them.

Since the discovery of carboniferous fossils, it is not unreasonable to expect, or at least to hope, that beds of true coal will eventually be found. A large bed of coal crops out on the seashore fifteen miles or thereabout, north of San Diego. At Elsinore also a bed of coal or lignite has been discovered on section twenty-six, township five south, and range five west, S. B. M., but no systematic exploration has been made. An approximate analysis of the latter will be found under the head of lignite. Salt is known to be very abundant, and since my last report extensive works have been undertaken along the shore of the ancient lake. I am informed by those interested that the enterprise is so far a success. My examination of the desert in 1881 led me to hope that nitrate of soda would be found. Other salts, in beautiful crystals, observed in the mud at that time should be examined by a competent chemist in the interest of the State. The so called desert lands are known to be very fertile, wanting water only to change them into a paradise. The climate is tropical, but exceedingly dry; rain seldom falls. The mountain divide separates two very distinct climates. To the east the country is hilly, and to a rather limited extent is traversed by streams of pure water. The hills are green and covered but rather sparsely with timber. The valleys are very fertile and well adapted for settlement, and the rainfall is sufficient to insure a crop nearly every year. This portion of the county has an approximate area of six thousand and eighty-four square miles, or three million eight hundred and ninety-three thousand seven hundred and sixty acres—a surface larger than the State of Connecticut.

Along the seacoast the climate is delightful. This portion of the county will undoubtedly support a large population. San Diego harbor is second only to that of San Francisco. The city is destined to become a great commercial center at no very distant day. The western slope of the divide is gradual, while that to the east is abrupt. This is the general character of all the mountain chains in California. The prospect of this county becoming a prolific gold-producing locality increases with the developments that have been made. Mines known to be productive have been discovered in the county in the Julian, Pinacate, and Carga Muchacho Mining Districts, while a vast area of unprospected country remains to be looked after.

The Carga Muchacho Mines, from discovery to June 17, 1882, worked fourteen thousand tons, which yielded $167,000, since which time the district has been idle. The mines lie in sections nineteen, twenty, twenty-nine, thirty, and thirty-two, in township fifteen south, range twenty-one east. Pinacate District is in the northwest corner of township five south,

range three west. The locality of Julian District will be given elsewhere. Besides gold and silver, the following minerals have recently been found in San Diego County: asbestus, clay, gypsum, mica, ocher, orthoclase, pegmatite, quartz. There are no doubt may others which will eventually be found and utilized.

The stage road from San Diego to Julian Mining District, sixty miles more or less distant, crosses a fertile and beautiful country. It passes through a succession of fine valleys—Cajon, Nuevo, Ballena, and Santa Ysabel. The ascent is so gradual that the stage is able to make the distance without difficulty in one day.

The following are roughly approximate altitudes taken with a good aneroid barometer, but by a single reading only:

Halfway House	180
Ridge near Cajon	510
El Cajon Valley	220
Rim of Cajon Valley, east	375
Fosters	260
Foot of Atkinson's grade	410
First bench	720
Head of grade	1,220
Summit	1,215
Nuevo	1,200
Foot of Hunsacker grade, four miles from Nuevo	1,760
Top of grade	2,230
Ballena Valley	2,240
Santa Ysabel Valley	2,700
Top of Coleman's grade, five miles from Julian	3,400
Julian City	4,000
Banner	2,800

For the first ten miles from San Diego heavy banks of drift, coarse gravel and bowlders are met with. Then a large outcrop of coarse granite may be seen, which presents a singular appearance, from spots or blotches of a darker color.

Santa Ysabel Valley is circular. It contains much good land. At the time of my visit it was covered with a luxuriant growth of wild oats. The rocks from this point to Julian seem to be syenitic. On Hunsacker's Grade there is a large outcrop of orthoclase and pegmatite, of a quality suited for the manufacture of fine pottery. At the town of Julian, near the Owens mine, coarse granite with mica crystals crops out. The country about Julian is generally mica schist, and of a quality bearing a striking resemblance to that about Dahlonega, in Georgia. I was struck with a marked likeness in other respects between the two districts.

JULIAN MINING DISTRICT.

This district, formerly called also Cuyamaca Mining District, was discovered and located in November, 1869, by Mike Julian, Webb Julian, James A. Bailey, and D. D. Bailey. These men had been prospecting in Arizona and Montana with indifferent success. In December placer mines were found, and worked in a small way. The first quartz mine discovered was the Van Wirt; the next the George Washington. Both were located on the same day, February 22, 1870.

The first Julian District, organized February 15, 1870, was bounded as follows, taken from the Recorder's books:

> Beginning one thousand yards west of Harrold's Store and running north five miles and south five miles, and four miles west in width.
>
> M. S. JULIAN, District Recorder.

and several other mining districts. The following com-

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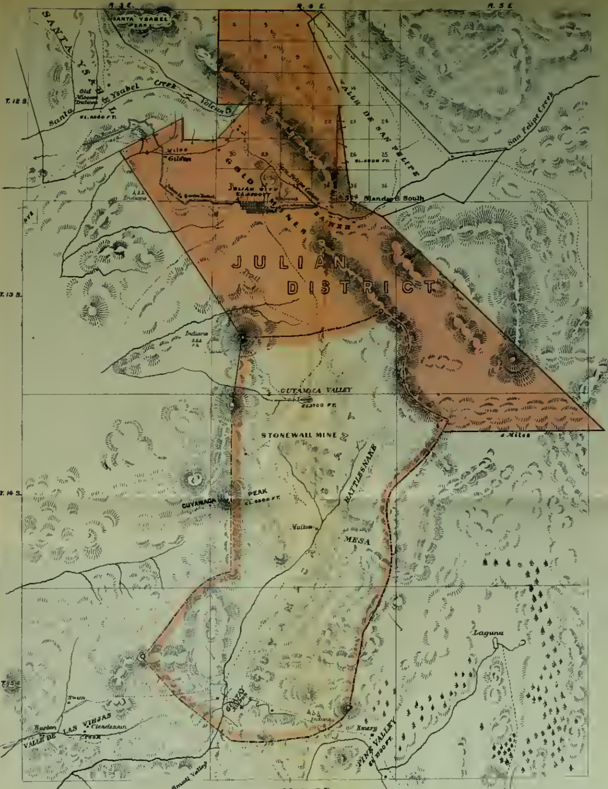

MAP OF
JULIAN DISTRICT
SAN DIEGO CO.
CAL.

The following is a statement by the Recorder of mines located up to August 30, 1870:

CERTIFICATE OF MINING LOCATIONS.

STATE OF CALIFORNIA,
County of San Diego. } ss.

I, M. S. Julian, Mining Recorder in and for Julian District, in the said County and State, do certify that the record books of the said district in my possession show that the following claims were taken up in pursuance of the laws and resolutions of the said camp, and that the names of the claimants are as given below, and that the quantity claimed and the date of the claim are as hereinafter given—that is to say:

George Washington—400 ft.; February 22, 1870; H. C. Bickers, etc.
Otilia—2,000 ft.; February 26, 1870; Mark Garrett, etc.
Wall Rock—2,400 ft.; February 20, 1870; John Fetherstone, etc.
Hammell—1,200 ft.; February 22, 1870; Wm. H. Hammell, etc.
Ida—1,200 ft.; February 22, 1870; Levi Hammell, etc.
Van Wirt—1,200 ft.; February 22, 1870; Calaway Putman, etc.
War Path—2,000 ft.; March 14, 1870; A. B. Woods, etc.
Hayden—1,000 ft; March 4, 1870; Paul Hayden, etc.
Good Hope—1,800 ft.; March 7, 1870; Geo. W. Swain, etc.
Lincoln—950 ft.; March 9, 1870; H. D. Young, etc.
Owens—1,000 ft.; March 11, 1870; James Kelly, J. E. Pember, Barney Owens, Francis Murphy.
High Peak—1,400 ft.; March 4, 1870; S. Southerimer, etc.
Washoe—2,200 ft.; March 6, 1870; Felix Fitzpatrick, etc.
Ione—2,000 ft.; March 2, 1870; D. D. Bailey, etc.
Aguadiente—2,000 ft.; March 21, 1870; H. E. Bingham, etc.
Monroe—2,400 ft.; March 24, 1870; Charles F. Monroe, etc.
Andy Johnson—1,200 ft.; March 22, 1870; John Bush, etc.
San Diego, No. 1—2,200 ft.; March 2, 1870; John P. Chambers, etc.
Keystone--1,200 ft.; April 2, 1870; J. M. Broom, etc.
Bedrock--1,200 ft.; April 2, 1870; John W. Pace, etc.
True Hope—1,400 ft.; June 6, 1870; J. B. Wells, etc.
Gilman—1,600 ft.; April 13, 1870; L. S. Gilman, etc.
Monitor—1,800 ft.; April 4, 1870; S. W. Black, etc.
Eagle—1,600 ft.; April 5, 1870; Wm. J. Moran, etc.
Leslie—1,400 ft.; April 6, 1870; Robert Leslie, etc.
Fairview—1,000 ft.; February 22, 1870; F. Scarborough, etc.
Crown—1,000 ft.; March 16, 1870; Frank Able, etc.
Horseshoe—800 ft.; April 4, 1870; C. R. Philips, etc.
Lone Star—1,200 ft.; February 28, 1870; J. Parsons, etc.
Rough and Ready—1,200 ft.; May 17, 1870; M. Martin, etc.
Challenge—2,000 ft.; May 10, 1870; O. P. Powers, etc.
Fair Play—1,600 ft.; May 26, 1870; R. J. Carroll, etc.
Swain—1,200 ft.; June 8, 1870; W. H. Swain, etc.
Pioneer Mill—1,400 ft.; May 1, 1870; James McMechan, etc.
I. X. L.—1,400 ft.; May 27, 1870; William Estes, etc.
Owens, First Extension—1,000 ft.; June 15, 1870; G. V. King, etc.
Crown Prince—600 ft.; April 2, 1870; R. Shelton, etc.
Crown, First Extension—800 ft.; June 29, 1870; D. Lipman, etc.
Home Stake—1,000 ft.; April 12, 1870; Joseph Moss, etc.
Farley—1,000 ft.; March 28, 1870; Richard M. Farley, etc.
Hudson—600 ft.; June 14, 1870; E. C. Phelps, etc.
Golden Rule—1,200 ft.; June 21, 1870; A. Pauly, etc.
North America—1,000 ft.; July 5, 1870; E. A. Ary, etc.
Sullivan—1,000 ft.; June 28, 1870; D. O. Sullivan, etc.
Victoria—1,000 ft.; July 11, 1870; M. Jones, etc.
San Francisco—1,200 ft.; March 21, 1870; J. P. Wealand, etc.
Minnesota—1,000 ft.; July 18, 1870; S. A. Coolidge, etc.
Little Giant—2,000 ft.; April 12, 1870; A. P. Dodge, etc.
Shamrock—1,000 ft.; April 23, 1870; John Madin, etc.
O'Connor and Ryan—2,200 ft.; April 4, 1870; David O'Connor, John Ryan, etc.
Owens' Ext. East—400 ft.; April 13, 1870; George McNier, etc.
Sonoma—1,800 ft.; March 28, 1870; B. T. Williams, etc.
Roanoke—1,400 ft.; March 28, 1870; Eli McDaniels, etc.
Hayden, First E. Ext.—1,200 ft.; April 11, 1870; Eugene Kelly, etc.

And I further certify, that the said claims are within the said Julian District, in the said county and State. In witness whereof I have hereunto set my hand and affixed my private seal, there being no public seal for said district, this third day of August, A. D., 1870.

[SEAL.] M. S. JULIAN, Recorder.

The Present Julian District, called JULIAN MINING DISTRICT, consolidates *Julian*, *Banner*, and several other mining districts. The following com-

mittee reported March 27, 1881: D. D. Bailey, Robert Gardner, George V. King, Committee.

The district is bounded as follows: commencing at the northeast corner of section four, township twelve south, and range four east, San Bernardino meridian, and running three miles west, to the northwest corner of section six; thence south three miles, to the southwest corner of section eighteen; thence east one mile, to the southeast corner of section eighteen; thence southwest along the line of the Santa Ysabel grant, to the southeast corner of said grant; thence along the line of said grant, in a westerly direction, four miles; thence in a direct line to the northwest corner of the Cuyamaca grant; thence along the north boundary of said grant, to the northeast corner; thence along the line of said grant, five miles; thence east five miles; thence north to the southwest corner of San Felipe grant; thence along the westerly line of said grant, to the place of beginning.

MINING LAWS OF JULIAN DISTRICT IN 1870.

At a meeting of the miners of Julian Mining District, held April 27, 1870, in pursuance of a notice given, by posting same in three public places, five days previous to said meeting, M. S. Julian acted as Chairman, and L. B. Hopkins, Secretary. The meeting being called to order, the committees appointed to revise and amend the mining laws of the district, reported the following:

Substitute for Article IV of the present laws, and the following additional laws:

ART. IV. All locations shall be recorded within ten days from the date of location, and shall have at least one day's work done on the claim prior to recording, and shall have at least one day's work done for each name on the notice or record within thirty days from date of record; and two days' work for each name so recorded done within sixty days from date of record; shall hold the claim and ledge free from relocation for one year from date of record, provided, said work be measured and recorded by the District Recorder.

ART. VI. All persons locating claims in this district shall erect a stake or monument on a prominent point on his claim, at least two feet high, upon which he shall place a notice defining the extent and boundaries of his claim, with the name of the ledge, and each owner in the same, and keep the same up permanently; and the same rule shall apply to all claims now located; and, further, that all claims that shall fail to have a stake, monument, or notice for the space of fifteen days consecutively, shall be subject to forfeiture, unless the party owning shall be able to prove sickness or other inability to comply with said law.

ART. VII. These laws can be altered or amended by a general meeting of the miners, called by a notice posted in three public places in the city, naming time, place, and object of the meeting, and signed by ten miners of the district.

ART. VIII. These laws shall take effect and be enforced from and after their passage.

On motion, the above report and laws were received and adopted for the future government of the district.

M. S. JULIAN, Recorder and Chairman.
April 27, 1870. L. B. HOPKINS, Secretary.

Julian City, once a thriving town, was at the time of my visit somewhat dilapidated; some of the houses were empty, but a new brick building had just been erected, a ten-stamp quartz mill was being built at the Owens Mine at the edge of the town, and other signs of renewed prosperity were manifested. The town is nearly at the summit of the Santa Ysabel Mountains. On a clear day, Point Loma at San Diego, and the Coronado Islands may be plainly seen. From the Oriflamme Mine, a short distance east, the desert, sloping away to the east, is in full sight. The principal street in Julian bears N. 63° west, magnetic.

In 1871 the town had a population of five hundred, and there were one hundred occupied houses. In 1873 the excitement which followed the discovery of the district began to subside. The cause was said to be prejudice against the lower country, and threatened litigation as to the boundaries of the Cuyamaca grant. This was eventually decided in favor of the miners.

In 1870 there were two quartz mills, of fifteen stamps Washoe pattern, at work. The gold was richer on the surface. Placer mines were worked in the low hills of the Santa Ysabel Valley, but they did not pay very well.

Bullion began to be shipped from Julian in April, 1871. Up to the middle of September $10,341 had been sent forward by Wells, Fargo & Co., and $5,580 by others. The gold was worth $18 per ounce. The following table, from the report of Rosseter W. Raymond for 1870, will give a good idea of the character of the district at that time:

MILLING RESULTS OF LOTS OF ORE FROM VARIOUS MINES IN JULIAN DISTRICT.

Name of Mine.	Tons Crushed.	Value per Ton.	Value of Crushing.
Lone Star	5	$70 00	$350 00
Owens	16	51 00	816 00
High Peak	10	42 00	420 00
Hayden	19	40 00	760 00
Pride of the West	1½	31 00	46 50
San Diego	19	15 00	285 00
Forty-nine	12	12 50	150 00
Lone Star	7	7 00	49 00
Keystone	4	7 00	28 00
San Diego	51	6 00	306 00
Sherman	4	4 82	19 28
North Star	6	4 50	27 00
North America	6	4 00	24 00
Monitor	6	4 00	24 00
Shamrock	7	3 50	24 50
Hannon	3	3 50	10 50
Eagle	10	2 90	29 00
Eagle	5	2 75	13 75
Ella	3	1 25	3 75
White Fawn	3	0 37	1 11
	197½		$3,387 39
Average per ton			$17 15

At the time the prosperity of this mining district was at its heighth, the San Diego *Union* estimated yield of gold for 1871 at $175,919, and for 1872 at $488,670.

After a careful examination of Julian Mining District, I am led to the following conclusions:

The quartz veins are generally rather narrow but remarkably rich. First and last there has been an important output of bullion from the district. I have not had time to arrange statistics obtained, in shape to be of much service. Wood and water are scarce; none of the mines have yet been opened or explored sufficiently to prove their capacity to yield gold. Considering the present condition of things in California, these mines can be worked to greater advantage than when first opened. Milling near Julian City cannot be conducted without very considerable difficulty, owing to the altitude, and consequent scarcity of fuel and water, but at Banner, six miles distant by graded road and twelve hundred feet lower in altitude, there is a beautiful valley through which a considerable stream of water—the San Felipe River—flows, affording sufficient water-power to drive several small mills or one large one, during the year; the water is more abundant during the winter months.

If first class reduction works should be placed at Banner, with ample capital, and all the ores from the district be worked in them, an era of

prosperity would probably be the result which would exceed any before experienced in this district, employment would be given to many miners and tributors to the advantage of the district, the county, and State. The locality is a delightful one, and a desirable place for residence, which is not always the case where gold mines are found.

Julian City lies in sections five and six, township thirteen south, range four east, S. B. M.

BANNER DISTRICT

Is situated on sections two and three, township thirteen south, and range four east, and joins Julian on the east. It was discovered in August, 1870, by a party of men from Julian who were looking for wild grapes. A mine afterwards called the Redman was discovered on a sloping mountain side in San Felipe Cañon. BANNER DISTRICT was soon afterward organized. The district now incorporated with Julian has many advantages, the most important being the presence of water in abundance for milling and sufficient for limited water power, limited to season only, for in the winter and spring, I was informed, it is ample for any future requirements of the district. As mentioned before, Banner is twelve hundred feet lower than Julian, from which it is distant three and a half miles by trail and six miles by graded wagon road. To work the mines of the consolidated districts to the best advantage all the milling and concentration should be done by water power in San Felipe Cañon, and the ores from all the upper mines brought down by a tram road for reduction. By this plan all the present difficulties would be overcome. From appearances, ores could be supplied to such general reduction works for many years to come. There is more silver and less gold in the bullion produced in Banner than that taken from the Julian veins. In 1870, when many mines were being worked in both districts, bullion from Julian sold at the stores for $16 per ounce, while Banner bars brought only $12 to $14. The following table shows the condition of the principal mines in Banner during the early mining excitement. The information is compiled from various publications and reports:

Name of Mine.	Average Yield.	Width of Vein.	When Discovered.	Remarks.
Golden Chariot	Most productive in the district. 100 tons yielded $32,000; 50 tons, $8,100; 52 tons, $13,261.	2 to 4 feet.	February, 1871.	Contact vein, country slate and granite. In July, 1874, cleaned up $9,500 in 12 days, with 10 stamps.
Kentuck	$40 per ton.	16 inches.	October, 1870.	Shaft 80 feet deep.
Madden	$75 per ton.	At 80 feet, 14 inches.	September 10, 1870.	
Ready Relief	10 tons yielded $980.	From 2 to 8 feet.	August, 1870.	Tunnel 130 feet, claim 1,000 feet in length.
Redman		6 to 10 feet.	August, 1870.	First mine discovered in the district. Shaft 80 feet deep, and tunnel connecting.

At the time of my visit only one mill was running on the ores of the Ready Relief or Bailey Brothers' Mine. Some other mines were being prospected in a small way, but with what success I was not able to learn. In 1874 there were seventy-five stamps running in Julian and Banner.

When I was at Julian City there was no mill running, but at the Owens Mine, almost in the Town of Julian, a new and good ten-stamp mill was being built. The vein in this mine is small, but the quartz is rich in gold. A pile of ore has been accumulated which contained several hundred tons, and looked and prospected well; from which it is fair to predict that enough gold will be taken out to pay for the mill and leave a surplus. While the new mill is running the mine will be well prospected, and there is reason to hope and expect that considerable bodies of ore will be found. There is no special or well defined croppings to be seen on the surface. The old workings have fallen in. There is a shaft down one hundred and eighty feet in depth, well timbered, through which the ores are hoisted. The mine lies three hundred feet above the town, and very near the summit of the ridge. To the left is a gap through which the road to Banner runs. On a hill near the town, and to the left of the road, may be seen some old workings in which there are some splendid quartz croppings, but in small detached fragments, in a schistose formation dipping at a steep angle. I was struck with the resemblance of this formation to that in Findley Ridge, at Dahlonega, in Georgia, and was led to the inquiry if it would not pay to pipe it down as they do there. A full description of the methods employed in Georgia may be found in the fifth annual report of this office, folio 142.

The Owens Mine was located March 11, 1870. The old workings were quite extensive. There was a shaft two hundred and seventy-five feet, from which levels ran east and west. The first level, one hundred feet below the surface, ran east two hundred feet and west one hundred feet. The second level, two hundred feet deep, ran two hundred feet east and one hundred and eighty feet west. Third level, at bottom of shaft, ran east two hundred and sixty feet and west two hundred feet. In eight months, ending June, 1873, gold to the value of $42,319 50, was taken from nine hundred and twenty tons of quartz. The company was incorporated with a capital stock of $500,000. In 1873 there were fine hoisting works at the mouth of the shaft—now removed.

READY RELIEF MINE, BANNER.

The Ready Relief Mine, the only one now being profitably worked in old Banner District, was discovered in August, 1870, immediately after the Redman, of which it is an extension. It is generally known as the Bailey Brothers' Mine. The southerly extensions of the Ready Relief Mine are the Hubbard and the South Hubbard. The claim is one thousand by two hundred feet. The ledge is from eighteen inches to eight feet in width. The vein is interstratified with the clay slate formation. The slaty cleavage of the country rock is undoubtedly due to lateral pressure, which has also distorted and plicated the vein so that it is found in folds, which are technically called "rolls." I am inclined to the opinion that the vein was formed by solfataric action in a plastic mud before the mountains were elevated, and that the vein has become plicated by its own weight while still in a soft condition. After visiting the mud volcanoes in this county—and not many miles distant—now in action, it is not difficult to conceive such an idea. These mud volcanoes are described in the second annual

report of this office, folio 227, to which the reader is referred. The plications of the vein are unlike anything I have ever seen or read of.

The engraving conveys a good idea of one of these folds as seen at the end of the upper tunnel. The slates are highly aluminous. In the tunnels the sides are soon coated with an incrustation of alum.

The ore in the Ready Relief Mine is blue ribbon quartz, much resembling that of the Sheep Ranch Mine in Calaveras County. The gold is free. The sulphurets are concentrated and saved, but I have no information as to their value. Some of the clay slate contains gold; it resembles the ores of the Black Hills in Dakota, and those of the old Oso Mine in Mariposa County. These slates should be thoroughly prospected and cross-cuts made from both sides of the vein. It might be found that they would pay to crush in large water-power mills with economical management. The general direction of the vein is south southeast. The dip is at almost any angle, owing to the folds before mentioned.

In 1874, the mine was opened by three tunnels, one two hundred feet, the others one hundred and fifty feet each; at the end of the upper tunnel there was a shaft to the surface, one hundred and ten feet above. The mine at present is worked by an upper tunnel of five hundred feet, and a

shorter one sixty feet below, through which ores are conveyed to the mill. Owing to the uprise shaft, the ventilation in the mine is perfect.

The mill is in rather a dilapidated condition, but is still doing good work. It consists of two batteries of five stamps, and driven by steam. The stamps weigh about seven hundred pounds. Each battery is supplied with an automatic ore feeder. Below the aprons there are three Hendy's concentrators, which save a considerable quantity of sulphurets. The mill is only run ten hours per day, during which seven tons of ore are crushed. Wood costs $1 50 per cord for cutting, and $2 for hauling to the mill. The mill is forty feet below the lower tunnel, from which the ores are carried in chutes. The dump of the mine, in which the rejected vein matter is piled, contains some good ores, and I am of the opinion that it would all pay in a large, economical mill. A great deal of low grade ore could be obtained from the hill alongside of the vein. An inexpensive experiment would reveal the value of this ore, and decide if it could be made to pay or otherwise.

In 1876 one hundred tons of ore yielded $30 per ton. The present average yield is not stated, but is admitted to be satisfactory. It is claimed that the output to the present time exceeds $350,000. The gold is worth $14 50 per ounce.

Mr. Charles J. Sauer thinks the water in the south fork of San Felipe River runs twelve miners' inches in summer, and much more in winter. I visited, with Mr. Bailey, a spring which gushes from the hillside at an elevation of five hundred feet above the mill. At the time of my visit, in May, the quantity flowing was at least thirty inches, and Mr. Bailey informed me that the flow was nearly the same all the year round. With the great altitude, this water would afford power sufficient to run extensive reduction works.

The Oriflamme Mine is situated in what was formerly the Desert Mining District, now incorporated in Julian. It belongs to a Boston Company, "*The San Diego Development Company*." Their ten-stamp mill has recently made a run which Mr. Henry M. Dow, the Superintendent, informed me yielded from $4 to $10 per ton. Water and wood are scarce, and mining and milling are conducted under difficulties. From this mine the Great Colorado Desert may be seen for many miles to the eastward. The sight is a very grand and interesting one.

The Stonewall Mine, formerly the *Stonewall Jackson*, is situated in the northern part of the Cuyamaca Grant about seven miles distant from Julian District in a direct line. By road it is considerably further. If the United States section lines were run out, it would lie in section four, township fourteen south, and range four east. It is not in the Julian District, as may be seen by referring to the map published with this. It has the reputation of being the largest vein in the mining region about Julian City. I regret that for want of time I could not visit this mine.

In 1870 the Stonewall was reported to be twenty feet wide. Dr. J. E. Fulton, one of the present owners, informed me that the width varied from six to forty feet. The country rock is said to be like that of Julian District—a mica schist with coarse granite. The ores are now being crushed in a steam-driven mill of ten stamps. I am informed that the mine has produced in nine months $85,000. The last clean-up yielded $40 per ton. The United States Mint has bought gold from this mine for $18 per ounce. The mine is opened by a vertical shaft one hundred and fifty-five feet deep, from which levels are driven. The lay of the country is such that there is no way to drain the mine by adit. Water for milling and for the steam

boiler is brought in iron pipes a mile or more, from the mountains. In 1871 the mine had a shaft one hundred feet deep, and a level at sixty feet running one hundred and eighty feet to the north and one hundred feet to the south. Stoping had not then commenced.

This promising mine has always been worked under difficulties. In 1871, the small mill then in operation could only run five hours each day for want of water. At that time the mine is said to have yielded from $12 to $20 per ton. During my stay in San Diego County I heard the mine invariably well spoken of.

CALIFORNIA MINERALS.

Mineral species known at the present time to exist in the State of California, carefully revised and corrected and brought up to date, intended to be a check list and foundation for future work. All technical or scientific descriptions have been omitted except in case of minerals not mentioned in former reports, or where some special work has been done, or some interesting feature discovered or noticed. The list has been arranged alphabetically for convenience of reference.

1. AGALMATOLITE. Minerals resembling agalmatolite occur in San Luis Obispo County, and at Greenwood, El Dorado County, the latter in a vein or stratum from six inches to a foot in thickness.

Agate—See Quartz.

Alabaster—See Gypsum.

2. ALBITE. Soda feldspar, a specimen in which quartz crystals are imbedded, was found in the San Lucas Mine, Inyo County. It is now in the private cabinet of Dr. Gould at San Diego. Dana gives as a locality the vicinity of the Murchie Mine in Nevada County, with gold and pyrite. The abundance of soda in the desert soils in California would indicate albite in the crystalline rocks.

3. ALTAITE. Telluride of lead, said to exist in Rawhide Ranch Gold Mine, Tuolumne County; in the Frenchwood Mine, Robinson's Ferry, Calaveras County, with petzete, calaverite, and other tellurium minerals; also in the Morgan Mine, Carson Hill, Calaveras County, in large masses, with free gold; at the Adelaide Mine and the Golden Rule Mine, in Tuolumne County, and elsewhere in the State.

4. ALUM. Occurs in mineral waters; as an incrustation, ten miles north of Santa Rosa, Sonoma County; near Newhall, Los Angeles County; near Auburn, Placer County; in thick incrustations at the Sulphur Bank Quicksilver Mines, Lake County; said to occur at Silver Mountain, Alpine County; at Howell's Mountain, Napa County; at the mud volcanoes, San Diego County, and at numerous locations, as an incrustation on rocks; I have noticed it on the bedrock laid bare by hydraulic streams, near Dutch Flat, Placer County, in a crystalline state.

Amianthus—see Amphibole.

5. AMPHIBOLE. Actinolite, anthophyllite, amianthus, asbestus, hornblende, mountain cork, mountain leather, tremolite, etc.

Actinolite. Abundant in counties bordering on the Bay of San Francisco; found in bowlders, or rolled masses, in Alameda and Contra Costa Counties, which show, when broken, beautiful green radiating crystals; found in rocks of the Coast Range; near Knight's Ferry, Stanislaus County; at Petaluma, Sonoma County, with garnets; on the Mariposa estate, Mariposa County, in fine needle crystals; in Quartz Eagle Gulch, Plumas County; twelve miles from Gilroy, Santa Clara County; Eureka, Humboldt County; Santa Rosa, Sonoma County; Reed's Ranch, Marin County; and in the Lone Mountain Cemetery, San Francisco.

Anthophyllite has been found in Slate Range, San Bernardino County.

Asbestus—

Butte County. Eighteen miles south of Oroville.

Calaveras County. Salt Spring Valley and Jenny Lind Hill.

Del Norte County. Exact locality not stated.

Fresno County. French Gulch, Potter Ridge Mining District, near Fresno Flat; Fine Gold Gulch.

Inyo County. Numerous localities in the Inyo Mountains.

Los Angeles County. Near Newhall.

Mariposa County. Mount Bullion and Bear Valley.

Placer County. Swiss Boy and Leed's claims, one mile below Rice's bridge.

San Diego County. Seven miles east of Elsinore, section six, township five south, range three west, S. B. M. This deposit is now being worked and boiler covering, etc., manufactured at Elsinore.

Shasta County. Exact locality unknown.

Tulare County. White River.

Yolo County. California Mine.

Hornblende—

Calaveras County. At Vallecito.

Contra Costa County. At San Pablo.

Monterey County. At Soledad.

Sacramento County. At Folsom.

Sonoma County. At Healdsburgh, and as a constituent of rocks in numerous localities in the State.

Mountain Cork has been found in Butte County, at Red Hill, and in Tuolumne County.

Mountain Leather. Amador County, in Little Grass Valley Mine, Pine Grove District, and in Mariposa and Tuolumne Counties.

Tremolite. Found white and fibrous in limestone at Columbia, Tuolumne County, and in Santa Cruz Mountains, Santa Cruz County.

6. ANDALUSITE. Found in abundance in the slates in Fresno and Mariposa Counties. In the former county, on the Chowchilla River, near the road to Fort Miller, or Millerton. In the latter, at Hornitas, at Moore's Hill, twelve miles south of Mariposa, and near the Ne Plus Ultra Mine.

Andradite—see Garnet.

7. ANGLESITE. Sulphate of lead. This is rather a common mineral in southeastern California, and specially so in Inyo County. In the Cerro Gordo it has yielded a very considerable portion of the lead bullion sent from that locality. It occurs with bindheimite and linarite and galena, at the Modoc Mine, and with geocronite and argentiferous galena and sinerite at the Santa Maria Mine, and the Eclipse Mine in the same county.

8. ANHYDRITE. Anhydrous sulphate of lime, found near Anaheim, in Los Angeles County, and in pale blue fibrous specimens in the Inyo Mountains, near Lone Pine; lately found in considerable quantity in the gypsum beds in Santa Barbara County—gray, very dense and heavy, compact to granular; shows signs of sedimentary origin.

Anhydrous Sulphate of Soda—see Thenardite.

Anthracite—see Mineral Coal.

Antimony—see Cervantite and Stibnite.

Antimony Ochre—see Cervantite.

Antimony Sulphide—see Stibnite.

9. APATITE. Phosphate of lime. According to the report of the San Jacinto Tin Mining Company of San Bernardino County, this mineral, rare in California, has been found near the company's property in San Bernardino County. No special description is given of the mineral or its occurrence.

10. ARAGONITE. Carbonate of lime, found in beautiful transparent crystals in Colusa County in the Candace Copper Mine; New Almaden Quicksilver Mine, Santa Clara County; Inyo County, Cerro Gordo Mines; Colusa County, ranch of J. M. Pugh, near Smithville.

Onyx Marble, a variety of aragonite, is found also in numerous localities, as follows:

Kern County. Six miles from Kernville.

Los Angeles County. Santiago Cañon, twenty-five miles from Santa Ana, in a ledge twelve feet thick.

Placer County. At Gold Run.

San Luis Obispo County. On section nine, township thirty-two south, range fifteen east, and at several other localities.

Siskiyou County. Near Soda Springs Hotel, and near Yreka.

Solano County. Near Suisun; near Vacaville, and elsewhere in the county.

Tehama County. In township twenty-five north, and range seven west, in a vein four feet thick.

Aragotite—see Petroleum.

Arenaceous Limestone—see Calcite.

11. ARGENTITE. Silver glance, vitreous silver, sulphuret of silver, found in Inyo County, in the Minietta Belle Mine; in the Kearsarge Mountains, near Independence, in cubical cystals; in Deep Spring Valley, at a depth of sixty feet from surface.

In *Mono County,* eight miles south of Benton.

12. ARSENIC. Metallic arsenic has been found at the Alisal Mines, twenty-five miles from the Mission of San Carlos.

Arsenical Pyrites—see Arsenopyrite.

13. ARSENOLITE. Exchequer Mine, Alpine County, after enargite; at the Armagosa Mines, San Bernardino County, in large masses.

14. ARSENOPYRITE. Mispickel. This mineral is quite abundant in California, but generally in thin seams rich in gold. The following are localities where it is found in uncommon masses, or of superior quality:

Calaveras County. Eureka Mine, with gold.

El Dorado County. With gold, near Georgetown.

Inyo County. Several localities.

Nevada County. Betsey Mine, Grass Valley.

Placer County. Near Auburn, with tellurium and gold.

San Diego County. Rich in gold.

Sierra County. North fork claim, Forest City, rich in gold.

Asbestus—see Amphibole.

Asphaltum—see Petroleum.

15. ATACAMITE. Chloride of copper. Locally given in Dana's Mineralogy, Inyo County; this is doubtful. I am familiar with the county, and have never seen or heard of a specimen being found.

Aventurine—see Quartz.

16. AZURITE. Azure copper ore, chessy copper, blue malachite, mountain blue. It is quite common in the Inyo Mountains, from the White Mountain to Coso, with cerusite, bindhermite, anglisite, and linarite; in the Modoc Mine, in Inyo County, and with chalcopyrite and bornite at Copperopolis, Calaveras County.

17. BARITE. Barytes, cawk, heavy spar, terra ponderosa, etc. This mineral is known to exist in at least six counties in the State, as follows:

Alpine. Morning Star Mine.

Calaveras. Satellite Copper Mine.

Inyo. In White Mountain Range; in a vein in Alabama Range.

Nevada. With gold, Malakoff Hydraulic Mine, North Bloomfield.

Plumas. With lead and copper ores, north arm of Indian Valley; with tetrahedrite, Irby Holt Mine, Indian Valley.

San Bernardino. Milk white and honey yellow, Calico silver mines.

18. BERNARDINITE. Near Santa Monica, Los Angeles County, described by J. M. Stillman, in American Journal of Science and Art, third series, volume 18, folio 57. It has since been found near Santa Rosa, in Sonoma County.

19. BINDHEIMITE. Hydrous antimoniate of lead. This rare mineral has been found at the Union Mine, Cerro Gordo, Inyo County, and with anglesite at the Modoc Mine, in the same county. There is some doubt as to the identity of the specimens.

20. BIOTITE. Hexagonal mica. Grass Valley, Nevada County. A specimen was seen by Professor Blake in the cabinet of C. W. Smith, Grass Valley.

BISMUTH—see Bismutite.

21. BISMUTITE. Hydrous carbonate of bismuth, stream bismuth. Found at a single locality in the State, on Big Pine Creek, Inyo County, found in drift while sluicing for gold.

BITUMEN—see Asphalt, under head of Petroleum.

BLACK JACK—see Sphalerite.

BLACK SANDS—see Magnetite.

BLENDE—see Sphalerite.

BLOODSTONE—see Quartz.

BLUE MALACHITE—see Azurite.

BORACIC ACID—see Sassolite.

22. BORATE OF STRONTIA. Mentioned in a letter written by Dr. John A. Veatch to the California Borax Company, quoted in full in the third annual report, part 2, folio 15.

23. BORAX. Borax was first discovered in California in the waters of Tuscan Springs, in Tehama County, January 8, 1856. The water was brought to San Francisco by Dr. Trask, State Geologist, and the analysis made by L. Lanszweert. The crystals then obtained were sent to the museum of the California Academy of Science. Borax Lake was discovered by Dr. John A. Veatch, in September, 1856. This deposit was worked from 1864 to 1868, during which time it produced 1,181,365 pounds of borax. Borax fields were discovered in San Bernardino County, February 14, 1873. These deposits have been worked by the San Bernardino

Borax Mining Company, who have produced very large quantities of borax. This valuable mineral has since been found at a number of localities in the State: In Death Valley, Inyo County, 1873; at Desert Springs, called also Cane Springs, in Kern County, February 15, 1872, from whence a considerable quantity has been extracted. The dry lake in which the borates are found is situated in township thirty south, range thirty-eight east, Mt. Diablo base and meridian. Borax and the borates have been found in considerable quantities in San Bernardino County, near Calico, which deposit is at the present time being worked.

The reader is referred to former reports of this office, especially the third annual report, for information concerning this mineral and its production in the State.

24. BORNITE. Erubescite, horseflesh ore, purple copper ore, variegated copper ore, etc.

Calaveras County. At Copperopolis and Campo Seco.

Fresno County. With chalcopyrite and pyrite, at King's River.

Inyo County. Inyo Mountains.

Plumas County. Light's Cañon, Genesee Valley, and at the Siegel Mine.

Santa Clara County. Near Lexington.

Shasta County. At Copper City.

25. BRONZITE. For localities, see Enstatite.

BUHR STONE—see Quartz.

BUILDING STONES, there not being many species, they have been described under a special heading.

26. BROMINE. Said to occur with free iodine in the serpentine rocks, at Point Lobos, near San Francisco. Report on the geology of the coast mountains, etc., J. B. Trask, State Geologist, 1884, folios 26 and 92.

Bromine occurs as bromide of potassium in the waters of San Francisco Bay, and in the bitterns or concentrated mother liquors, from which bay salt crystallizes out in the proportion of 1.090 parts in 1000 as shown in analysis made in 1879, by Fr. Gutzkow, and quoted in the second annual report of this office, folio 223.

27. CALAVERITE. Telluride of gold and silver. This mineral occurs sparingly in the mines of Carson Hill, near Angel's, at the Morgan Mine with massive gold, at the Melones Mine, and at the Golden Rule Mine, Calaveras County.

28. CALCITE. Anthraconite, arenaceous limestone, carbonate of lime, calcareous spar, calc spar, dogtooth spar, Iceland spar, limestone, lithographic stone, marble, stalactite, stalagmite, travertine, tufa, thinolite, etc. This mineral is abundant in California, and occurs in many forms. It is found not only in extensive beds, but as distinct varieties, resulting from changes well known to mineralogists. It is a common mineral in veins of silver, lead, copper, zinc, and quicksilver, and sparingly in gold mines. It would be impossible and useless to enumerate all the localities in the State, but the following are given as the most important and best known:

Amador County. Black calcite, near Volcano.

Butte County. Blue limestone and anthraconite, at Pence's ranch.

Calaveras County. *Anthraconite*, near newly discovered caves at Murphys. The odor of this mineral is remarkable. Sitting one day in the hot sun, and breaking while studying the rock, I noticed with much

interest the penetrating and actually fetid smell that arose every time a blow of the hammer was made. I was annoyed at the same time by swarms of flies, but did not immediately connect their presence with the smell. After a time the idea occurred to me that they were attracted by the odor, which I immediately proved to be the case by the following experiment: Leaving my seat, I retired to a distance and awaited the dispersion of the flies. Returning, I laid some fragments on a larger piece and crushed them quickly with rapid blows. The flies immediately reappeared and settled in large numbers on the powdered rock. After a time, the smell having gone, the flies departed as before. This was repeated a number of times, and was witnessed with interest by the parties who were visiting the cave at the time.

El Dorado County. A large deposit of limestone at the Alabaster Cave and lime works, where it is very extensively burned for lime; near Mud Springs.

Inyo County. Thinolite found in considerable quantity near Owens' Lake, and on the Mohave Desert, in the beds of ancient lakes; and in Death Valley, at Cerro Gordo; fine crystals of dogtoothspar and blue calcite occur; at Darwin, Iceland spar, very transparent and fine; at Palma Mine, fine crystals; with gold and other ores at Modoc Mine.

Kern County. With malachite and melaconite, San Amedio Ranch. Lithographic stone on section twelve, township thirty-two south, range thirty-four east, Mount Diablo meridian.

Lassen County. Several localities.

Mariposa County.

Mono County. Thinolite, valley of Mono Lake, where it has been burned to an inferior quality of lime.

Placer County. Near Clipper Gap; extensively burned to lime at Cave Valley, five miles south of Auburn.

San Bernardino County. Near Colton, burned for lime by hydrocarbon furnace, in which California petroleum is used as fuel.

San Diego County. Thinolite, Colorado Desert.

San Francisco County. Peninsula near the city, dogtooth crystals in fissures of metamorphic rocks.

Santa Clara County. Hills back of Mayfield, burned for lime. Good specimens of Iceland spar are sometimes found; with quicksilver ores in the New Almaden, Guadalupe, and Chapman Mines.

Santa Cruz County. Near Felton and Santa Cruz, extensive beds of crystalline limestone occur, which is burned in a large way for lime.

Siskiyou County. Arenaceous limestone, found in Middleton's tunnel, under the bed of the Klamath River.

Santa Catalina Island. On the coast of Los Angeles County, pink calcite is found, with quartz, etc.

Tufa, or travertine, is found in several localities, but it has not been studied.

MARBLES occur in numerous localities in the State; some of them are of excellent quality, and a few are exceptionally fine.

Amador County. Near Ione, a red marble is found which resembles the Rosso Antico, so much prized in ancient Rome. This marble is fully described under the heading of Building Stones. Nine miles from Ione a white marble of good quality is found.

Butte County. A blue variety crops out for miles near Pence's Ranch; it is known to be carboniferous.

Calaveras County. Near Cave City, a beautiful marble of a pleasing, soft pearl-gray color with darker markings; takes a fine polish; is compact and without flaws; it is an elegant ornamental and desirable building stone.

El Dorado County. At Alabaster Cave a nearly white marble is found, but it has not as yet been carefully studied; a gray mottled variety from near the same locality takes a good polish, and is a good building material.

Humboldt County. Seven miles from Eureka, a handsome mottled gray marble of uniform texture; takes a high polish; soluble in acids; contains but little magnesia, and seems to be an excellent stone. It is located on the timber claim of Flanegan & Brosman.

Inyo County. Numerous marbles have been observed in the Inyo Mountains, from white to black, but little is known of them. At Big Pine, at the foot of the Sierra Nevada Range, there is a cropping of beautiful white marble, but it has never been examined chemically and may be dolomite. In Death Valley a blue limestone is found in bowlders among the float filled with what seems to be fossil coral; if cut and polished it would probably be found to be a fine marble.

Kern County. A water-worn bowlder of marble of good quality was found in the bed of Poso Creek; the source is not yet known. A brecciated marble resembling Giallo antico is found three miles from Tehachapi, and a soft yellow and really very beautiful marble is found in a valley nine miles west of the town of Tehachapi. It is found in large masses. There is one large block at the station at Tehachapi which was never shipped. The marble is fine grained and beautifully mottled. These marbles are described in detail under the head of Building Stones. They are worthy of special attention.

Los Angeles County. There are two varieties of marble known to occur in this county; one light colored, the other dark. But little is known otherwise of them.

Monterey County. Near Carmello Bay, a white compact marble is found which is said to exist in very large quantities. A company was incorporated some years ago to work it, known as the Pacific Carrara Marble Company.

Nevada County. On Bear Creek, near Colfax, a dark gray-veined marble is found. Another locality is ten miles south of Grass Valley.

Placer County. Near Clipper Gap, gray-veined marble of good quality; takes a high polish; occurs in large quantities. Analyses of two varieties are published in the fourth annual report of this office, folio 111. A white marble occurs at and near the cave, in the vicinity of Auburn.

A white saccharoidal marble is found near the iron furnaces, in section fifteen, township fifteen north, range eight east. It could be obtained in large blocks or slabs if required. An analysis may be found on folio 111, fourth annual report of this office.

A very beautiful black marble, veined with white, has been found near Colfax, on the Central Pacific Railroad. It is an excellent ornamental and building stone, and should be utilized.

A large cropping of light gray marble, with veins and markings of darker gray, has been opened in a lime quarry near Auburn. It is in very large quantity. It is compact, of uniform structure, and takes a high polish. An analysis appears on folio 111 of the fourth annual report.

Plumas County. Limestones and marbles have been found at Devil's Elbow. This office has no information as to quality or quantity.

San Bernardino County. Near Colton, in Slover Mountain, half a mile from town. The marble is white and of good quality, but I am informed that it has not yet been found of a quantity that will admit of large blocks being quarried. It is extensively burned for lime.

San Luis Obispo County. Marbles in many varieties are said to occur in this county, but this office has no special information.

Santa Cruz County. At the lime works mentioned elsewhere, a crystal-limestone is found that has some of the properties of marble.

Shasta County. Marbles are found in the Gray Mountains, along the McCloud River. No specimens have been sent to the Mining Bureau.

Tuolumne County. This county is rich in marbles and limestones. A beautiful dark marked variety is found near Abbey's Ferry; the exact locality is not known. In the bed of the Tuolumne River, at Sonora, a large water-worn outcap of a blue and white marble is laid bare in placer mining.

Carbonate of Copper—see Malachite and Azurite.

Carbonate of Iron—see Siderite.

Carbonate of Lead—see Cerusite.

Carbonate of Magnesia—see Magnesite.

Carbonate of Soda—see Trona.

Carnelian—see Quartz.

29. CASSITERITE. Binoxide of tin.

Tin has been found in at least three localities in California. In the Temescal Mountains, San Bernardino County, lies the only known deposit in the State, having a prospective value. In Plumas County, in the bed of the middle fork of Feather River, three miles above Big Bar, a single specimen was found by Mr. Thomas Lane of La Porte, and given to Professor W. P. Blake, and by him described as resembling the stream tin from Durango, Mexico. Another specimen was found some years ago near Weaverville, Trinity County, in the loose soil, and presented to Professor J. D. Whitney, then State Geologist. The vein from which it came was never found.

Grossularite, lime garnet, a common mineral in Southern California, resembles crystals of cassiterite, and has often been mistaken for it by Cornish miners. A number of reported tin discoveries have turned out to be this mineral. The temescal tin mines are in the Temescal Mountains, whence the name, on section two, township four south, range seven west, San Bernardino meridian; distant fifty-five miles east of Los Angeles, and thirty-five miles from Anaheim Landing.

Cat's eye—see Quartz.

30. CERARGYRITE. Chloride of silver.

Cerargyrite is rather a common mineral in some of the southern counties of the State, associated with embolite, but seldom in masses sufficiently large to form good cabinet specimens. Microscopic crystals of great beauty are not uncommon, but the mineral generally occurs in very thin crusts.

It forms the chief silver mineral in Slate Range, Inyo County. The finest microscopic crystals are found in the Modoc Chief Mine, Inyo County. Cerargyrite is a valuable silver mineral, and is easily reduced by the most simple metallurgical process.

It has lately been found in the Silver King Mine, four miles west of Redding, Shasta County. The ore contains minute, but very perfect, crystals of cerargyrite. An assay showed silver to be present to the extent of 140 ounces to the ton. The ore resembles the best from Calico District, in San Bernardino. The specimens were sent to the Mining Bureau by B. B. Miner.

31. CERUSITE. White lead, carbonate of lead, white lead ore, etc.

This mineral is very easily distinguished, and is rather common in California, seldom in crystals, but generally associated with galena, anglesite,

azurite, linarite, chrysocolla, malachite, silver minerals, and gold. Fine crystallized specimens, with the associates above mentioned, are found in the Modoc Mine, and in many other localities, in the Inyo and Coso Mountains, Inyo County; in the Russ District, in the same county, in large crystals resembling those from Siberia, and at Great Basin Mine, near Mohave River (Blake). It is a valuable ore of lead, and in certain localities an indication of silver ores. A considerable proportion of the lead ores worked at the Cerro Gordo Mines were cerusite. Thirty-two thousand tons of lead were produced in these mines.

32. CERVANTITE. Antimony ochre.

This is a rare mineral in California. It occurs with stibnite in San Emedio Mountain, Kern County. (Blake.)

33. CHALCANTHITE. Native sulphate of copper, blue vitriol.

Results from the decomposition of copper sulphide ores and is rare in nature. It sometimes occurs in old copper mines in California when the waters do not flow from the workings, and old tools such as picks, gads, hammers, etc., left by accident in the old works, have been found changed to metallic copper, or very heavily coated with that metal. Specimens in the State Museum are from the Peck Mine, Copper City, Shasta County, and from Sweetland, Nevada County.

The waters of a copper spring near Glenbrook, Lake County, deposit copper on a knife blade.

Chalcedony—see Quartz.

34. CHALCOPYRITE. Copper pyrites. This mineral is quite abundant in California, being found in greater or less quantities from north to south. It is a valuable ore of copper; but its metallurgy presents so many difficulties that it is found generally more profitable to concentrate it and ship it to England than to work it here. Under some circumstances it has been found economical to reduce it to a matte by a single furnace operation, and ship it in that condition. It is also worked somewhat extensively at Campo Seco, Calaveras County, and at Spenceville, Nevada County. The following California localities are represented in the State Museum:

Calaveras County. Campo Seco, Copperopolis, and Lancha Plana.
Colusa County. Stony Creek.
Contra Costa County. In the rocks of Mount Diablo.
Inyo County. Beveridge District.
Los Angeles County.
Mariposa County. Near Hornitos.
Nevada County. At Spenceville.
Plumas County. Bullion District and Light's Cañon.
San Bernardino County.
San Diego County.
San Francisco County. In specks in the jaspers of the peninsula.
Santa Clara County. At Lexington.
Shasta County. Copper City.

It occurs also in small quantities with ores of gold and silver, and is almost universal in its distribution over the State.

35. CHALCOSITE. Vitreous copper, copper glance.

It is found with other ores of copper in the State, more frequently in the southern counties. It is sometimes argentiferous, and merges into stromeyrite, which see. It occurs in the silver ores in Inyo and San Bernardino

Counties; in Genesee Valley (in basalt), Plumas County; in San Diego County; in Los Angeles County; at the Maris Mine, in grains and irregular masses, in syenitic granite, containing silver (Blake); in San Luis Obispo County; and in the Enterprise Mine, Bullion District, Plumas County.

CHESSY COPPER—see Azurite.

CHLORIDE OF SILVER—see Cerargyrite and Embolite.

CHLORO-BROMIDE OF SILVER—see Embolite.

CHLORO-CARBONATE OF LEAD—see Phosgenite.

CHROME IRON—see Chromite.

36. CHLOROPAL. Nontronite.

This mineral has been found recently at two localities in California, one near Hite's Cove, Mariposa County, and in lava at Bath, in Placer County. A specimen from the former gave the following reaction: Color, piscatio green; cuts like soap; easily indented or cut by the finger nail; lumps under the pestle; gives water in closed tube; with borax on platinum wire, gives iron reaction; on charcoal, in reducing, flame turns black and becomes strongly magnetic. Partly soluble in hydrochloric acid; dissolves in caustic soda, leaving a black residuum.

37. CHROMITE. Chromic iron, chrome ore, etc.

This mineral is very abundant in California. Its occurrence and production have been fully described in the fourth annual report, folio 126.

It is known to exist in at least twenty-six counties in the State, as follows. Nearly all the localtties are represented in the State Museum:

Alameda County. Near the Town of San Antonio; in Livermore Valley, nine miles southeast from section thirteen, township three south, range two east; 1,500 tons 48 per cent shipped to Philadelphia; 60 tons sold at $6; 500 tons offered at $5, without sacks.

Amador County. Near Jackson, one mile from Mountain Spring House.

Butte County. Mount Hope District, near Forbestown.

Calaveras County. French Gulch; near Domingo Creek; near Campo Seco; near Murphy's; in San Diego Gulch, on the east of the highest hill opposite the Noble Copper Mine, in very large masses.

El Dorado County. Two miles from Coloma; two miles northwest of Shingle Springs; ten miles west of Shingle Springs; near Latrobe.

Fresno County. Near the New Idria Quicksilver Mine; twenty miles from Fresno City.

Lake County. At Lower Lake; on the road from St. Helena to Knoxville; at Glenbrook, a large quantity. Mr. H. Aldrich thinks 1,000 tons could be obtained from this locality.

Los Angeles County. Lang's Station, Soledad Cañon; occurs with magnite, in the form of sand.

The Los Angeles papers assuming the mass to be chrome iron, estimate the quantity at 50,000 tons, which is without doubt a mistake. It is not uncommon in California to find chromite with magnetic sands, but not in such large proportion.

Mendocino County. At Stanley's Ranch.

Monterey County. Near San Benito River.

Napa County. Near St. Helena, in Chiles Valley; 170 tons delivered at St. Helena, sold for twelve dollars per ton.

Nevada County. Deer Creek, Coyote Diggings, near Colfax.

Placer County. Near Alabaster Cave, Michigan Bluffs, within one mile of Auburn, on section twelve, township fourteen north, range nine east, seven miles east of Iowa Hill.

Plumas County. Spanish Creek, Meadow Valley.

Sacramento County. Seven miles east of Folsom, near south fork of American River; nine miles from Folsom; 2,800 tons have been shipped from this locality.

San Francisco County. Several unimportant deposits are known on the peninsula, one on the ocean beach below outlet of Lake Merced, one on the hills south of the city.

San Luis Obispo County. Chrome iron is abundant in this county. The Flores deposit has been extensively worked. The Pick and Shovel Mine is six miles northeast of the town of San Luis. The London Mine is four and a half miles northeast of the town. Extensive mines lie five miles southeast of San Luis. Very large quantities of chrome ores have been shipped from this county. The county papers estimate the product at over twenty-eight thousand tons.

San Mateo County. Chrome ores are found in this county, on the Pacific Slope of the redwoods. The deposits are said to be large.

Santa Clara County. Five miles east of San José; Los Gatos.

Sierra County. Vicinity of the Mountain House, near Downieville; Cherokee Creek, one fourth of a mile southeast of Brandy City.

Siskiyou County. Half a mile from the town of Yreka—a high grade ore.

Solano County. Near Fairfield.

Sonoma County. Near Litton Springs, in large quantities; at Hood's ranch.

Tehama County. A large deposit has recently been found in township twenty-five north, and range seven west, by J. A. Heslwood; a company has been incorporated.

Tulare County. Deer Creek, near Plano, and ten miles from Portersville.

Tuolumne County. The Engel Mine at Yorktent, near Chinese Camp, has been worked for many years.

Chrome Spinel—see Picotite.

38. CHRYSOCOLLA. Silicate of copper. Rather an abundant mineral in southern California. It is regarded in Owens' Valley as an indication of silver mines. It is found as a blue stain on ores of copper and silver, and in the vicinity of mines of these metals. Fine specimens are found in the Copper World Mine, San Bernardino County; in the Lundy Mines, Mono County, associated with ceragyrite and cuprite, and in the Union Mine, Inyo County, and forty miles south of Colton, San Bernardino County. It occurs also near San Carlos, Inyo County; at the Eclipse Mine, same county; in the White Mountains, Mono County; in San Diego and San Luis Obispo Counties, and elsewhere in the State. It is a valuable ore of copper, for the reason that it can easily be reduced in the water jacket furnace to metallic copper.

39. CHRYSOTILE. This is a magnesian mineral, a variety of serpentine, having no economic value. It occurs in veins or seams in serpentine, and is not uncommon in the State where the serpentines occur.

40. CINNABAR. There are in this State many deposits of cinnabar. The counties most distinguished for their wealth in this mineral being Santa Clara, Fresno, San Luis Obispo, Trinity, Napa, Sonoma, and Lake, all containing mines that have been more or less, and in some of which mines are still being worked. The localities are so numerous that like those of gold it would be tedious and unnecessary to mention them all. Under the head of *Mineral Springs*, it will be seen that the influences which have led to the deposition of cinnabar, pyrite, native mercury, calcite, aragonite, quartz, sulphur, bitumen, and gold, are still in active operation, and as cinnabar is the mineral from which most of the quicksilver has been extracted in California, it is proper to give under this head the following statement of the product of that remarkable and useful metal for the years 1885–6, furnished by Mr. J. B. Randoll; by referring to the same subject in former reports, the entire yield for California may be learned :

PRODUCTION OF QUICKSILVER IN CALIFORNIA FOR THE YEAR 1885-86.

(Black figures are the production of 1886.)

	Ætna.	Napa C.	Great Western.	Guadalupe.	New Idria.	Sulphur Bank.	Redington.	Great Eastern.	Various.	Total—flasks.	New Almaden.	Grand Total—flasks.	Price in San Francisco—per flask. Highest.	Price in San Francisco—per flask. Lowest.
January	189 **162**	131 **147**	172 **339**	0 **0**	190 **70**	24 **100**	40 **42**	37 **73**	0 **34**	783 **967**	1,700 **1,431**	2,483 **2,398**	$33 00	$32 50
February	96 **132**	180 **192**	245 **274**	35 **0**	70 **175**	85 **108**	24 **24**	75 **53**	0 **45**	810 **1,003**	1,506 **1,100**	2,316 **2,103**	$32 50	$32 50
March	88 **209**	145 **218**	314 **226**	0 **0**	80 **20**	83 **91**	0 **21**	33 **43**	19 **75**	762 **903**	1,500 **1,522**	2,262 **2,425**	$32 50	$31 00
April	142 **328**	145 **172**	310 **115**	0 **0**	80 **90**	69 **172**	0 **36**	37 **62**	0 **62**	813 **1,037**	2,003 **1,256**	2,816 **2,293**	$31 00	$30 00
May	62 **228**	190 **128**	269 **99**	0 **0**	75 **101**	194 **36**	0 **18**	0 **76**	3 **95**	793 **781**	2,000 **1,600**	2,793 **2,381**	$29 00	$28 50
June	112	250	330	0	62	91	50	63	5	963	1,750	2,713	$30 00	$29 00
July	45	191	321	0	75	209	43	50	10	941	1,750	2,691	$30 00	$29 75
August	118	175	324	0	80	150	49	0	47	913	2,101	3,047	$29 75	$29 50
September	201	180	347	0	95	85	57	0	77	1,042	1,936	2,978	$30 50	$29 50
October	52	185	236	0	85	123	42	65	82	870	1,598	2,468	$30 50	$30 00
November	51	190	292	0	122	61	43	43	87	892	1,576	2,468	$30 00	$29 75
December	150	235	279	0	130	122	37	43	62	1,058	1,977	3,035	$32 00	$30 00
Totals	1,309	2,197	3,469	35	1,144	1,296	385	446	392	10,673	21,400	32,073	$32 00	$28 50
Production in 1884	2,931	1,376	3,292	1,179	1,025	890	881	332	7	11,913	20,000	31,913	$35 00	$26 00
Production in 1883	*	5,890	3,869	84	1,606	2,612	1,894	1,669	101	17,725	29,000	46,725	$28 50	$26 00
Production in 1882	....	6,842	5,179	1,138	1,953	5,014	2,171	2,124	241	24,662	28,070	52,732	$29 05	$27 35
Production in 1881	....	5,552	6,241	5,228	2,775	11,152	2,194	1,065	584	34,791	26,000	60,851	$30 75	$27 90
Production in 1880	....	4,416	6,442	6,670	3,209	10,706	2,139	1,279	1,600	36,461	23,465	59,926	$34 45	$27 55

* Production of Ætna and Napa Con. not segregated in former years.

Clay—see Kaolinite.
Coal—see Lignite.
Cobalt—see Erythrite and Millerite.
Cobalt Bloom—see Erythrite.

41. COCCINITE. Iodide of mercury.
Locality given by Dana, San Emidio Cañon, Kern County.
Colemanite—see Priceite.

42. COPPER. Copper in the metallic state has not been found in any considerable quantity in California. The following are the known localities:

Calaveras County. Found sparingly in the Keystone, Napoleon, Lancha Plana, and Union Mines. The Satellite Mine, the Lancha Plana under a new name, has produced a fine lot of specimens which were exhibited by Horace D. Randlett at a late exhibition of the Mechanics' Institute at San Francisco.

Del Norte County. With cuprite, Pearl Mine.

Napa County. Near St. Helena.

Nevada County. Meadow Lake, with cuprite.

Plumas County. At Mumford's Hill, with rhodonite.

Sacramento County. Cosumnes Mine.

San Luis Obispo County. Pieces of float copper have been found in the Coast Range, sometimes associated with cuprite; one mass weighed 37.3 pounds.

Santa Barbara County. In grains in serpentine rocks (Blake).

Shasta County. Cow Creek and Iron Mountain.

Trinity County. With cuprite.

43. COPPERAS. Coquimbite in part, hydrous sulphate of iron, occurs in several localities in the State, and is generally the result of solfataric action, as at the Sulphur Bank, in Lake County, where it is very abundant. No analysis has been made of it, so that its exact composition is unknown. Dr. Trask, in his report of 1854, fol. 56, says it is found in large quantities near the town of Santa Cruz, in such quantity that it could be extensively manufactured as an article of commerce. I formed the same opinion as to the Sulphur Bank before mentioned. A sample of saturated solution of sulphate of iron was sent to the Mining Bureau recently, leached from ground sulphurets that the party who sent it states could be obtained at the rate of seventy gallons per ton. This is only another evidence of the enormous waste that is permitted in the metallurgy of ores in California.
Copper—Blue Carbonate—see Azurite.
Copper Glance—see Chalcosite.
Copper—Green Carbonate—see Malachite.

44. CORUNDUM. According to Baron Richthoven it is found in the drift in the San Francisquito Pass, Los Angeles County.

45. CUBAN. Sulphide of copper and iron. It is said to be found on Santa Rosa Creek, San Luis Obispo County. One mass weighed 1,000 pounds. I consider this statement as doubtful.

46. CUPRITE. Red oxide of copper. Cuprite is rather a common mineral in California. The following are the most important localities:

Colusa County. Candace Mine.

Del Norte County Pearl Copper Mine, with native copper.

Kern County. San Emedio Ranch, with malachite.

Mono County. Kerrick Mine, with azurite, malachite, partzite, and native silver.

At Lundy, in microscopic crystals, with cerargyrite and chrysocolla.

On the borders of Mono Lake and at Mammoth.

Napa County. Near St. Helena, in masses of considerable size, with native copper.

Nevada County. At Meadow Lake, with native copper.

Placer County. Near Lincoln.

Plumas County. Reward Mine.

Shasta County. Peck Mine, Copper Hill, in microscopic crystals.

Trinity County. With native copper, exact locality unknown.

Tulare County. May Flower Mine, Mineral King District.

And at numerous localities in the Inyo Mountains, Mono, and Inyo Counties.

According to Blake, it occurs sparingly in thin crusts and sheets with the surface ores of the principal copper mines in Calaveras County, especially the Union and the Keystone; in Mariposa County, at La Victoire Mine, with green and blue carbonates of copper; in Del Norte County, at the Evoca, Alta, and other mines, in very good cabinet specimens, the cavities being lined with crystal; in Plumas County, and in the upper parts of most of the copper veins of the State.

47. CUPROSCHEELITE. Tungstate of lime and copper. This new and interesting mineral was first found in California in the Green Monster Copper Mine, in Kern County, about twelve miles east of White River Post Office. It is generally associated with black tormaline. A large crystal was found at this locality, which is the only one of this mineral known. In 1879 a fine specimen was sent to San Francisco from Fresno County, but the exact locality was not given.

48. DATOLITE, OR DATHOLITE. This mineral has, as yet, been found at one locality only, but from the universal distribution of boracic acid in the State, it is likely to be found elsewhere. The locality is a mining tunnel near San Carlos, Inyo County. It occurs with grossularite in fine crystals, the datholite being the matrix in which the grossularite is embedded. This mineral was first noticed by the late J. Lawrence Smith, and an account of it published in the *American Journal of Science* a number of years ago.

49. DIALLOGITE. Rhodochrosite, carbonate of manganese. This mineral is represented in the State Museum by a single specimen, No. 3584, in beautiful pink crystals, from the Colorado Mine, No. 2, Monitor District, Alpine County.

50. DIAMOND. For the details of the occurrence of diamonds in California, and of general history, the reader is referred to the fourth annual report of this office, folio 157. The following are the known localities in the State:

Amador County. A very interesting stone was found in July, 1883, by George Evans, on the surface of the ground at Rancheria, a small mining camp, about four miles northwest of Volcano. It weighs about 255 milligrams. Its length is 0.315 inches; thickness, 0.215 inches. It is irregularly globular in form, all the faces being convex. It is pale straw colored, very

brilliant, and, as far as can be distinguished even under the microscope, is without a flaw. Jackass Gulch, near Volcano, and Indian Gulch, Gopher Hill, near Fiddletown, and other localities. Diamonds have been found at Volcano in a peculiar volcanic formation, described by Professor Whitney as "ashes and pumice cemented and stratified by water." The crystals had the form of the icositetrahedron, with faces curved in the manner peculiar to the diamond.

Butte County. A fine crystal was found some years ago in the west branch of Feather River. It was about four millimeters in diameter. It was afterwards lost. A number of diamonds have been found at Yankee Hill, but the exact number is not known.

A fine diamond from the Spring Valley Mine, Cherokee, has been presented to the State Museum, No. 4033, by Mr. G. F. Williams, Superintendent. Mrs. Harris has a beautiful Cherokee rough diamond set in a ring. Mr. Harris, who was formerly Superintendent of the Spring Valley Hydraulic Mine, has another, which has been cut. Of the two, I consider the natural crystal the most interesting and beautiful. Mrs. W. C. Hendricks of Morris Ravine, near Oroville, also has a fine Cherokee diamond set in a ring.

In August of 1883 I visited Cherokee, Butte County, specially to study that celebrated diamond locality. Mr. A. McDermott, druggist of Oroville, says that a diamond was sent to him in 1862 which was as large as a small pea. It was nearly globular and obscurely crystallized and of yellow color. He does not know the subsequent history of the stone, where it was found, or the owner's name.

At Cherokee, diamonds and zircons are found in cleaning up sluices and undercurrents. The first notice of diamonds at this locality dates from 1853, the largest discovered, which was two and a quarter carats (nine grains), is now in the possession of John More. There have been from fifty to sixty found, from first to last; some were rose colored, some yellow, others pure white, and all associated with zircons, platinum, iridium, magnetite, gold, and other minerals.

El Dorado County. Mr. W. A. Goodyear is quoted in Whitney's "Auriferous Gravels of the Sierra Nevada of California" as follows: "He saw a diamond in the possession of Mrs. Olmstead, at Dirty Flat, near Placerville, which measured nine thirty-seconds of an inch maximum diameter, and weighed one and a quarter carats—$5\frac{61}{100}$ grains. It was found by Mr. Olmstead in cleaning up the sluices of the Cruson tunnel, Dirty Flat.

At the McConnell & Reed claim, on the south side of Webber Hill, a diamond the size of a small white bean was found. This diamond was discovered a few feet above the bedrock. Mr. McConnell thinks on a previous occasion he had thrown away a diamond as large as the end of his thumb, in ignorance of its true character. Two other diamonds were found in another claim, also on the south side of Webber Hill.

Three or four diamonds were found near White Rock. Mr. Goodyear purchased a crystal of Mr. Thomas Potts. It weighed half a carat—two grains; had a slight yellowish tinge, and was found in washing the gravel which came from a tunnel driven into White Rock. Near the same locality three diamonds were found in gravel by the Wood Brothers, in 1867. The largest was valued by a San Francisco dealer at fifty dollars.

An interesting letter from Placerville to the State Mineralogist, from W. P. Carpender, gives much information on this subject. It is published in full in the fourth annual report, folio 169.

Nevada County. French Gulch—one crystal weighed $7\frac{1}{2}$ grains.

Trinity County. An examination of the platinum sands of the Trinity

River was made by Professor F. Woehler, of Gottingen, who found diamonds in them. After removing gold, platinum, chromic iron, silica, rhuthenium, etc., by the usual methods, he examined the residue microscopically, and observed colorless, transparent grains, which he presumed to be diamonds. Subsequent combustion in oxygen and precipitation from solution of baryta, by the carbonic acid evolved, convinced him that the microscopic crystals were true diamonds.

Diatomaceous Earth—see Quartz.

51. DOLOMITE. Carbonate of lime and magnesia. Inyo marble.

Dolomite is rather abundant in California. The following are the most important localities at present known:

Amador County. In narrow, snow-white veins, traversing talcose and chlorite rock bearing coarse, free gold. (Blake.)

Calaveras County. In the Winter, Hill's, and other mines, with quartz and free gold, sometimes in cavities, in fine crystals. (Blake.)

Inyo County. Dolomite is very abundant in the Inyo range of mountains, from White Mountain to Coso, and in very large deposits. The White Mountain Peak is named from its white appearance. The summit, which seems to be of this rock, is often supposed to be covered with snow, when it is not. Attention has lately been called to the white variety of this marble, which resembles the finest Carrara marble, from which the name "*Inyo marble*" has been taken. A technical description of this dolomite marble has been given under the head of Building Stones.

Los Angeles County. Tejunga Cañon, San Gabriel Mountains.

Mendocino County. Exact locality unknown.

Napa County. Mount Catherine.

Plumas County. With pyrite at Mumford's Hill.

San Bernardino County. In the Armagosa Mines, with free gold; also in the wash of the Armagosa River, in white bowlders, which, broken, resemble the finest Italian marble.

San Luis Obispo County. At Morro, in nodules resembling fossil coral; from less than an inch to several feet in diameter. Some have cavities lined with crystal.

52. DUFRENOYSITE. A mineral composed of sulphur, arsenic, and lead. Said to be found in the Union Mine, Cerro Gordo, Inyo County (doubtful).

Electrum—see Gold.

53. EMBOLITE. Chloro-bromide of silver. It is rather an abundant mineral in southern California, but is seldom found in masses of any considerable size, being generally disseminated throughout the other ores of silver, or occurring in crusts. It is almost always associated with cerargyrite, for which it is often mistaken. It is found in the Minnie Mine, Sweetwater Range, Mono County, and in the Indiana Mine, near Swansea, Inyo County. A large specimen of silver ore in the State Museum (brecciated), a large portion of which is covered with embolite, is from the Alhambra Mine, Calico District, San Bernardino County.

Emerald Nickel—see Zaratite.

54. ENARGITE. Sulpho-arsenide of copper, sometimes containing antimony, iron, silver, or zinc. It occurs at least at one place in California, where it is abundant, associated with pyrite and other minerals. It has a disposition to change to arsenious acid and sulphate of copper, a reference

to which has been made under the head of arsenolite. The locality is the Morning Star Mine, Monitor District, Alpine County, from which there are fine specimens in the State Museum. One remarkably fine specimen from the Stella Mine was presented by Lewis Chalmers. It is a nodular mass, surrounding a nucleus of pyrite. It is coated white on the surface from the decomposed mineral. The inner nucleus is in part amorphous, partly crystalline, of a pale gray color; where it joins the enargite it is pale yellow.

55. ENSTATITE. Bronzite.

Silicate of magnesia, alumina, iron, lime, manganese, etc. The variety Bronzite is found in Alameda County, in the Berkeley Hills.

56. EPIDOTE. Silicate of alumina, lime, iron, etc. Occurs sparingly in California, at Long Valley, on the Mohawk Road, Plumas County, and in Miners' Ravine, Placer County. It has been found with copper ores in Calaveras and El Dorado Counties, but the exact localities are uncertain.

57. EPSOMITE. Epsom salt, hair salt, sulphate of magnesia.

This rather rare mineral occurs in the Redington Quicksilver Mine, Napa County, in curved porous crystals several inches long, white color, nearly wholly soluble in water, gives much acid water in closed tube, and a black sublimate of sulphide of mercury which is present as an impurity. B. B. on ch. melts in its water of crystallization, and becomes pink on addition of nitrate of cobalt at a red heat.

A qualitative analysis shows it to contain alumina and traces of iron. The small residue left after solution in water was examined microscopically and found to consist of black, yellow, and transparent particles, some sulphide of iron (pyrites), and a small amount of cinnabar. The black particles proved to be magnetite, the yellow free sulphur, and the transparent, selenite—altogether an interesting association, and one that will be studied more carefully in the future.

Epsomite has been found in an old drift in Ventura County, at Rincon. The tunnel is in two hundred to three hundred feet, and the mineral forms on the roof and sides in acicular needles two inches long. Specimens have been presented to the State Museum by Dr. Stephen Bowers, of Ventura. It is very soluble in water.

Erubescite—see Bornite.

58. ERYTHRITE. Arsenite of cobalt.

This rare mineral has recently been found in California and Nevada. It is found as a rose-red incrustation on a grayish earthy mineral at the Kelsey Mine, Compton, Los Angeles County. It was described by Professor William P. Blake in "Contributions to the Mineralogy of California," in the appendix to the second annual report of the State Mineralogist, 1882.

Feldspar—see Albite, Labradorite, and Orthoclase, and special paper on rocks and building stones.

59. FLUORITE. Fluor spar, fluoride of calcium.

Found only sparingly in small white cubes, with copper ore, at Mount Diablo, Contra Costa County (Blake).

Fluor Spar—see Fluorite.

French Chalk—see Talc.

Freibergite—see Tetrahedrite.

60. GALENA. Galenite, sulphide of lead.

Galena is a common ore of lead and very abundant in California. It is found in the northern part of the State with pyrite and blende, in the gold mines, and in the south with silver ores; sometimes disseminated through the ore, at other times in distinct veins, and in masses of considerable size. The time will come when by a proper system of concentration this mineral will be gathered and will add largely to the lead production of the world.

The following are some of the very numerous localities in the State; most of them are represented in the State Museum:

Amador County. Rising Sun Mine, near Aqueduct City.

Calaveras County. At Murphy's, in the Star of the West Mine, Blue Mountain District and Gold Hunter claim.

Inyo County. New Coso, Modoc, Brown Monster, and Hidalgo Mines, the latter showing radiated structure. In the Cerro Gordo Mines where a large quantity of lead has been produced, and at many other localities in the Inyo Mountains. All the ores containing this mineral are argentiferous.

Mariposa County. Marble Springs.

Mono County. In the May, Lundy, and Homer Districts, and with native silver and partzite, Tower Mine near Benton; there are numerous other localities in the county.

Nevada County. In several of the most noted mines with gold, and at Meadow Lake with gold and blende.

Plumas County. Light's Cañon and Granite Basin.

Sacramento County. At Michigan Bar, with blende and pyrites.

San Bernardino County. In many localities.

Santa Catalina Island.

Tehama County. At Cow Creek.

Tuolumne County. In white quartz, with coarse gold, pyrite, and blende; Soulsby Mine.

61. GARNET. Andradite.

Garnets are found in a number of localities in California, but no stones suitable for jewelry work, or which should be called gems, are known.

Garnets have been found in the following localities in the State:

Calaveras County.

El Dorado County. At Fairmount Mine, three miles from Pilot Hill, in large blocks and masses two feet thick or more (Blake); Rogers' claim, Hope Valley, with copper ores.

Fresno County. Near New Idria (chrome garnet).

Inyo County. Coso Mining District. Specimens have been brought to San Francisco, under the impression that they were tin ore.

Los Angeles County. Mountain Meadows, with copper ores.

Marin County. Reed's Ranch, in mica schist.

Mono County. Near Mono Lake.

Plumas County. Long Valley.

San Bernardino County. Near the Temescal Tin Mines.

San Diego County. Soledad Mine, near Santa Ysabel.

Santa Clara County. Thirty miles northeast of San José, in mica schist.

Sonoma County. Mouth of Russian River—near Petaluma, associated with specular iron, pyrite, chalcopyrite, calc spar, actinolite, and steatite.

Ventura County. Pine Mountains.

62. GAY-LUSSITE. Carbonate of lime and soda, found in alkaline lakes in fine crystals. It has no present economic value. Thinolite, which

forms mountains in Nevada and elsewhere in the Great Basin, is believed to be a pseudomorph after gay-lussite; if this is so, the quantity of carbonate of soda set free must also have been very great. This subject forms the substance of several chapters in the "Geology of the Fortieth Parallel," Clarence King. Gay-lussite is found in California at Borax Lake, San Bernardino County, and probably elsewhere.

63. GEOCRONITE. Sulphide of lead and antimony, has been observed with galena in small masses in the Inyo Mountains, Inyo County. A specimen was exhibited in the California collection at the Paris Exposition of 1878.

64. GLAUBERITE. Sulphate of lime and soda, was found at Borax Lake, Lake County, in blue clay at a depth of forty feet, having been obtained in an artesian boring (Dana). It is reported also in San Bernardino County, at the borax works, and it is said to exist at the Geysers in Sonoma County.

65. GLAUCOPHANE (Wichtisite). This mineral occurs in a rock matrix, widely distributed in California, and associated with serpentine. The rock was first observed in 1877, when sections were cut for microscopic observation. A specimen was exhibited at the Paris Exposition of 1878, and when seen by M. Michel Levy was recognized as the "Mica schiste a glaucophane de Syra, Greece," figured in his "Mineralogie micro-graphique des Roches Eruptive Françaises," planche 1, Fig. 2. This rock is represented in the State Museum by No. 4259. The wall rock of the Collier Mine, six miles northeast of Murphy's, Calaveras County, and microscopic slide from near the Wall Street Quicksilver Mine, Lake County. A slide from this was exhibited in Paris.

66. GOLD. Gold exists in nearly every county in California. To enumerate all the localities in detail would be useless. All the information this office has been able to gain concerning this most valuable of all metals may be learned by consulting previous reports of the State Mineralogist, the museum catalogues, and a special paper in this volume.

A very interesting specimen of gold imbedded in a quartz crystal has been exhibited at the State Museum. The following description is the result of a careful examination of this curious and interesting association. It is from Tuolumne County, and was one of several obtained at the same locality. It is now in the private collection of Mr. J. Z. Davis.

The gold is, within and without the crystal, projecting from a perfect face. It does not fill a cavity, but extends like a diaphragm through the quartz. The length of the quartz crystal is 42 millimeters, thickness 13 and 20 millimeters; weight, 14.670 grams; specific gravity, 2.699. According to the table given in Phillips' Metallurgy of Gold and Silver, the proportion of gold is .0429, or by weight—

Gold	0.629
Quartz	14.041
Total	14.670

Attached to the large crystal are two smaller ones, of smoky quartz, joined to the larger one by the gold. One of these crystals is very minute, the other is somewhat larger; the diameter of the smaller is, in decimals of an inch, .003, the larger is .0375.

The gold is bright, crypto-crystalline, leaf-like, curved in some parts like the gold found in some quartz mines in the State, specially the Cedarberg. The large crystal of quartz is well terminated at one end; the base is shattered and irregular. At the junction of the gold with the quartz the quartz is somewhat fractured, but the gold extends into the body of the crystal into the solid quartz. The face of the crystal which appears fractured, when examined under the microscope, seems to be a confused conglomerate of imperfect crystals of quartz in which some minute half-formed crystals of gold are imbedded. It is interesting to speculate as to the manner of the formation of this crystal, and to theorize how the gold came to be imbedded in it. At first thought it would seem to be conclusive that the gold was formed first and that the quartz crystallized about it; but they may be cotemporaneous, another evidence that quartz is deposited in a gelatinous state, from which it hardens into massive and even crystalline quartz.

It has long been known that gold existed in small quantities on the peninsula of San Francisco, within the city limits. A handy panner, or one skilled in the use of the improved batea, can at any time obtain one or more colors of gold in a panful of sand from the ocean beach or the shores of San Francisco Bay. A few ounces of gold have been extracted from the black sands on the beach near Lake Merced. A small portion of this gold has been obtained, rolled out into a ribbon, and placed in the museum as a specimen of gold from San Francisco County. It has been numbered 6530 in the museum catalogue. Some day this specimen will be prized as a relic of the golden era in California. Half an ounce of gold should be bought from every county in the State while it is possible, and carefully preserved in the State Museum.

67. GRAPHITE. Plumbago, black lead, etc.

The following are the known localities in the State:

Alpine County. Near Summit City.

Calaveras County. Near Big Tree Grove, in crystalline scales (Blake), probably molybdnite, for which it is frequently mistaken.

Fresno County. At Borer Hill.

Kern County. Near Fort Tejon.

Los Angeles County. Tejunga Cañon, twenty-five miles from Los Angeles, and twelve miles from S. P. R. R.

Sonoma County. Knights Valley, Guerneville, and near Pine Flat.

Tuolumne County. One mile south of Sonora, Gold Springs.

And reported in Marin, Plumas, and Sierra Counties.

No deposit of any considerable value has as yet been found in the State, and the quality is very inferior. Some of the specimens from localities given above, may be molybdenite, and this is even probable.

GRAY COPPER—see Tetrahedrite and Chalcosite.

68. GROSSULARITE. Lime garnet.

Is quite abundant in California, especially in the southern counties, where it has often been mistaken for tin by Cornish miners who have seen it, and several tin excitements have had their origin in this mistake. It is found also with copper ore in the Roger's claim, Hope Valley, El Dorado County (Dana), and, with datholite, near San Carlos, Inyo County.

69. GYPSUM. Alabaster, selenite, satin spar, plaster of Paris.

Gypsum is an abundant mineral in California. It has been found in numerous localities as follows:

Alameda County. Union Salt Works, a deposit left in the tanks in the preparation of bay salt.

Kern County. With stibnite in the Antimony Mines, San Emidio, near Breckenridge, Buena Vista, and Posa Creek.

Los Angeles County. Near the entrance of Soledad Cañon, and at a locality recently discovered.

Monterey County. Several unimportant localities.

Nevada County. Near Truckee Pass.

San Diego County. One or two miles from Elsinore, near Dos Palmas Station, banks of Carizo Creek.

San Luis Obispo County. Arroya Grande Mountains.

Santa Barbara County. With anhydrite.

The deposit in Santa Barbara County is of great excellence and very extensive, possesses the further advantage of being located within two miles of Point Sal, a shipping station on the coast for this portion of the county. This gypsum is of the white or Nova Scotia variety, being a kind well suited for making plaster of Paris, and which is said to occur abundantly at only a few other points in the United States. Since the discovery three years ago, five thousand tons have been brought to San Francisco and manufactured by Lucas & Co., who inform me that the supply cannot be exhausted in many years.

Stanislaus County. Near Hill's Ferry.

Ventura County. Ojai Ranch, Lockwood Creek.

Alabaster—

Los Angeles County. Arroyo Grande, San Luis Obispo County, and Point Sal, Santa Barbara County.

Sonoma County. In fine crystals, Santa Rosa.

San Luis Obispo County. Cholame.

Selenite—

Kern County. Antimony mines, San Emidio; Buena Vista.

Lake County. Robinson's Ranch.

Lassen County. Near Susanville, in large slabs.

Los Angeles County. Soledad Cañon, in large slabs.

Mariposa County. Bear Valley.

San Bernardino County. At and near Calico.

San Diego County. Dos Palmas Station, Southern Pacific Railroad.

Santa Barbara County. Point Sal.

Santa Clara County. Near Gilroy.

Stanislaus County. Near Modesto.

Ventura County. Lockwood Creek.

Satin Spar—

San Bernardino County, and Tulare County, near White River.

70. HALITE. Common salt.

The manufacture of salt was described in a special paper in the second annual report of the State Mineralogist. Since that report was published, several new salt springs have been discovered, and in sinking wells for petroleum salt water frequently rises.

Salt is known to exist in a mineral state in the following counties of the State: Alameda, Inyo, Kern, Los Angeles, Marin, Placer, San Bernardino, San Diego, Santa Clara, and others. In Inyo, Kern, San Bernardino, and San Diego Counties, it occurs in the great deserts and in the sinks of rivers which have no outlet to the sea. In Inyo County it is abundant in Owens', Saline, and Death Valleys, associated with borax, gay-lussite, hanksite, thenardite, iron, and ulexite. In Saline Valley, rock salt was discovered in

1864, in extensive beds. Large beds of salt have recently been discovered in the Alkaline Lake or sink in the Colorado Desert, in San Diego County, which are now being successfully worked by an incorporated company under the name of the New Liverpool Salt Company.

In *Alameda County* solar salt was found by the early settlers on the shores of the bay of San Francisco.

In *Kern County* it occurs fourteen miles from Cañada de los Uvas, where the ground is impregnated with salt; also in the Tehachapi Valley.

Salt springs occur in *Inyo County*, in numerous localities.

Los Angeles County. Fourteen miles from Los Angeles.

Placer County. Near Clipper Gap, and elsewhere in the State.

71. HANKSITE. This new mineral has been fully described in the fifth annual report of this office, folio 62 to 66. It has lately been discovered that it occurs in very large quantities and in a different form at the same locality, where the hexagonal crystals were found, and that a confused mass of dogtooth crystals in the State Museum are another form of hanksite. When this became known a doubt arose whether thenardite existed at all in California, but it was found that a massive variety, called *ice* by the borax miners, gave no reaction for carbonic acid and *all* the reaction for thenardite. It will be interesting when the Winter overflow of water at the locality in San Bernardino County subsides to obtain all the varieties, and to make a careful study of them. It is my opinion that instead of being a scarce mineral, hanksite will be found in great abundance, and that it will be proved that it plays an active and important part in the metamorphosis that produces gay-lussite, thinolite, and perhaps borax. Hanksite is known to occur in California in the borax fields in Death Valley, Inyo County, and in San Bernardino County, at the original locality. There are several known localities in the State of Nevada.

72. HEMATITE. Specular iron, micaceous iron, red hematite, sesquioxide of iron.

The reader is referred to a special paper on iron ores in fourth annual report, folio 232. Hematite is found in the following counties and localities in the State:

Alameda County. Near Alameda.

Alpine County. At Monitor.

Amador County. Ione Valley, near the Amador Gold Gravel Mine, two and a half miles northeast of Jackson.

Butte County (Micaceous). Feather River, near Oroville.

Calaveras County. Near Campo Seco, opposite section three, township four north, range ten east; near San Andreas—near the big tree grove.

Del Norte County. Kelsey tunnel, fourteen miles southeast of Crescent City.

El Dorado County. Diamond Springs township.

Inyo County. Owens Valley.

Napa County. Near St. Helena.

Nevada County. Holden ledge, township fifteen north, range seven east; large quantity; 1,000 tons shipped to San Francisco.

Placer County. Clipper Gap Iron Mine, on section twenty-four, township thirteen north, and range eight east; Red Hill, on section fifteen, same township and range.

Plumas County. With magnetite, near Crescent Mills; Mumford's Hill, and Light's Cañon.

San Luis Obispo County. Harrington Iron Mine, township thirty-one south, ranges eleven and twelve east.

Shasta County. Near Shasta.

Sonoma County. Specular iron, equal to that from Elba.

73. HESSITE. Telluride of silver. A single specimen was obtained in 1854, near Georgetown, El Dorado County. It had been washed out from the gold drift, and the parent vein has never been found (Blake).

HORNBLENDE—see Amphibole.

HORNSILVER—see Cerargyrite.

HORSEFLESH COPPER ORE—see Bornite.

HYALITE—see Opal.

74. HYDROMAGNESITE. A mineral, supposed to be hydromagnesite (no analysis), is found in the serpentines on the peninsula of San Francisco, and elsewhere in the State. It is represented by specimen No. 1320, in the State Museum.

ICELAND SPAR—see Calcite.

IDOCRASE—see Vesuvianite.

IDRIALITE—see Petroleum.

ILMENITE—see Menaccanite.

IODIDE OF MERCURY—see Coccinite.

IONITE—see Lignite.

75. IODINE. Dr. Trask found free iodine and bromine in the serpentine rocks at Point Lobos, San Francisco. ("Report on the Geology of the Coast Mountains, etc., J. B. Trask, State Geologist, 1854," fols. 26 and 92.) About seventeen years ago I made an analysis of mineral water containing a large quantity of iodine. The sample was furnished by Mr. Fargo, of San Francisco, who has since informed me that the spring from which it was taken was at the entrance of Grizzly Cañon, Lake County, five or six miles from Wilbur Springs. In a letter by Dr. John A. Veatch, quoted in the third annual report of the State Mineralogist, 1883, fol. 17, he writes: "Nothing of much importance presented itself until reaching the saline district, about eighty miles south of Red Bluff. It is on one of the branches of Stony Creek. Valuable salt springs exist here. The waters contain the borates in minute quantities, and one spring was remarkable for the enormous proportion of iodine salts held in solution."

76. IRIDIUM. Iridium has been found with gold and platinum in all the stream washings or placer mines of California; also in the auriferous beach sands. As not much effort has ever been made by the miners to save it, the quantity collected in this State has not been large. During the earlier stages of gold washing, when operations were prosecuted on a more extended scale, the miners finding this troublesome stuff in their sluices, where its great weight had retained it with the gold, were at much pains to separate it from the latter, after which, being ignorant of its value, the most of it was thrown away. Afterwards, when the miners found out what it was, they began to save this metal, and small lots, finding their way to San Francisco, were sold at such prices as happened to be offered for it, there being no regular purchasers in this market.

In melting gold in the United States Mint in San Francisco, and in the bullion refineries of the State, much iridium was collected which rose to the surface of the melted gold, and was skimmed off with the flux or dross. At the San Francisco Assaying and Refining Works, under the

management of Kellogg & Hewston, large quantities were so collected. The principal localities in the State where it has been found will be given under the head of platinum.

IRIDOSMINE—see Iridium and Platinum.

IRON GARNET—see Garnet.

IRON AND IRON ORES—see Hematite, Limonite, Magnetite, and Siderite. This subject has been somewhat fully treated in the fourth annual report of this office, folio 232.

ISINGLASS—see Mica, Brolite, and Muscovite.

77. JAMESONITE. Sulphide of antimony, lead, iron, copper, and zinc.

This mineral is represented in the State Mnseum by a single specimen, No. 2262, from Mokelumne Hill, Calaveras County.

JASPER—see Quartz.

78. JEFFERISITE. A mineral resembling mica, which is a hydrous silicate of numerous bases, principally alumina, iron, and magnesia. Specimens in the State Museum are (2126), from Susanville, Lassen County, and (4911), from Tulare County.

79. KAOLINITE. Including all varieties of clay resulting from the decomposition of feldspar. The numerous deposits of clay in the State and the condition of the pottery manufactures have been described at some length in the fourth annual report of the State Mineralogist, folio 139, to which the reader is referred for details. Clays are very abundant in the State, while some are admirably adapted for the manufacture of the finer quality of porcelain, others are useful only for the making of bricks. The following are the most important localities in the State, of the better quality; the inferior kinds are too numerous to mention:

Alameda County.

Amador County. Ione Valley, near Jackson.

Calaveras County.

Contra Costa County. Mount Diablo.

El Dorado County. Dutch Creek, twenty miles northeast of Placerville.

Humboldt County.

Inyo County. One deposit said to have an area of forty acres, ten feet thick; another opposite Independence.

Los Angeles County.

Marin County. Duncan's Mills.

Mendocino County. Near Point Arena.

Monterey County.

Napa County.

Nevada County. Seven miles southeast of Grass Valley, on section three, township fifteen north, range nine east, a large and very important deposit. Another is found on Rush Creek, three miles from Nevada City.

Placer County. Spinks' coal mine at Lincoln, one of the most important localities in the State; found also near Clipper Gap.

Sacramento County. Michigan Bar and Cook's Bar are important deposits.

San Bernardino County. In 1883 a deposit of very pure white kaolin of great value if in sufficient quantity was discovered at Calico.

San Diego County. Several large deposits have been found within six miles of Elsinore. Potteries have been established which are working the clay successfully.

Santa Clara County. Near San José.

Shasta County.

Sonoma County. Two miles from Santa Rosa.
Tehama County.

80. LABRADORITE. Feldspar.
This mineral has been observed in small quantities in street pavement blocks in San Francisco; the exact locality is not known.

81. LEAD AND LEAD ORES. See also galena, anglesite, and cerusite.
In the fourth annual report of this office, folio 244, the reader will find published a special paper on this subject. Metallic lead was said to have been found in a placer mine at Magalia, Butte County, in 1867. This was probably flattened bullets, which are very frequently if not invariably found in the clean up of hydraulic mines.

82. LENZINITE. Hydrous silicate of alumina.
MOUNTAIN BUTTER. Found in cavities in rocks at the mouth of Pine Creek Cañon, Alabama Range, Owens Valley, Inyo County. (Aaron.) This mineral is probably lenzinite.

83. LEPIDOLITE. Lithium mica.
This beautiful mineral has recently been found in California, at several localities, with erythrite and rubellite. It is a pink colored, scaly mineral, containing from two to six per cent of lithium. The California mineral has not yet been analyzed. It might, at some future time, be found profitable to extract lithium from it. The salts of lithium are principally used in fireworks and in medicine. The California localities are represented in the State Museum by Nos. 1229, San Diego County; 2773, twenty miles southwest of Colton, San Bernardino County; and 4262, with azurite, from the Half Dollar Mine, Inyo County.

84. LEUCOPYRITE. Arsenical iron.
Said to occur in Los Angeles County; exact locality not given.

85. LIGNITE. Brown coal, mineral coal, ionite, peat, etc.
One of the most pressing wants of California at the present time is extensive and accessible beds of good coal. It will be difficult, if not impossible, to compete otherwise with eastern manufacturers, who can purchase an unlimited supply of greatly superior fuel for less than one third the price paid by the same class of manufacturers on the Pacific Coast. The question of fuel becomes a very serious one when extensive manufactures on the Pacific Coast are contemplated.

While our mineral fuels of this class are neither cheap, abundant, nor of good quality, they serve a useful purpose, and are somewhat largely utilized. Even the brea, or crude asphaltum, is burned under steam boilers in some parts of the State.

As carboniferous rocks are known to exist in several parts of the State, there is reason to hope that true coal may be eventually found. The reader is referred to a special paper on the mineral coals of the Pacific Coast, on folio 265, fourth annual report of this office. The following California localities are known:

Alameda County. Corral Hollow.
Amador County. Ione Valley, in a vein of inferior quality, five to fifteen feet in thickness; several thousand tons have been burned in locomotives.
Butte County.
Calaveras County. Near Lancha Plana.

Contra Costa County. Mount Diablo, extending ten to twelve miles along the northern slope of the mountain; the most prolific locality in the State.

Fresno County. Six miles westwardly from the New Idria Quicksilver Mine.

Humboldt County. Near Eureka, on Eel River, thirty miles from Eureka, one hundred and fifty feet above the bed of the river; said to be a well defined and extensive bed of coal.

Kern County. Tejon Pass.

Lassen County. Near Bieber.

Los Angeles County. Four miles from Fulton—Santa Clara Coal Mine.

Mendocino County. Middle fork of Eel River, eight miles south of Round Valley—Willits.

Mono County. A vein six inches thick, twenty-five miles from Bodie.

Monterey County. South of Carmello Bay.

Placer County. At Lincoln, a very poor quality; it has been used, to a limited extent, for making steam.

San Benito County. Cienega del Gabilan Rancho, in the mountains east of Soledad.

San Bernardino County. Temescal Mountains, twenty-five miles west of Colton, Cajon Pass, said to be a fifteen-foot vein; if an analysis published in the San Diego *News* is correct, the coal is of superior quality.

San Diego. Croppings of coal or lignite were known in this county many years ago. R. C. Taylor, in his statistics of coal, published in 1855, but written before 1851, mentions the occurrence of coal on the seacoast, twelve miles north of San Diego, and the fact that the tooth of a saurian and amber were found with it. According to the statements of Dr. Le Conte, the vein is four feet thick. The writer also asserts that brown coal is found between San Diego and San Luis Rey (folio 497). According to the *Mining and Scientific Press*, coal occurs near the harbor of San Diego, on Point Loma (vol. 16, folio 81). A vein of lignite has been found four miles from Elsinore. It has been named the Cheney Coal Mine. It is developed to the extent of fifty feet, and is used as a cheap fuel. I have made an analysis which has not before been published.

ANALYSIS.

Fixed carbon	39.94	Inflammable	85.00
Volatile combustible matter	45.06		
Water	5.80	Non-inflammable	15.00
Ash	9.20		
	100.00		100.00

Streak, brown; does not cake or coke.

San Francisco County. Ore specimen found on Telegraph Hill had the following composition:

Combustible matter and water	75.7
Ash	24.3
	100.00

Another from the cemetery grounds, Presidio:

Fixed carbon	47.55
Volatile combustible matter	7.30
Water	4.40
Ash	40.75
	100.00
Inflammable	54.85
Non-inflammable	45.15

Small croppings of lignite are known to occur on the ocean beach.

San Luis Obispo County. Near the town, lat. 35° north; discovered 1847 (Statistics of Coal, R. C. Taylor, folio 497).

Santa Clara County. Near Lexington.

Santa Cruz County.

Shasta County.

Siskiyou County. Eight miles north of Yreka, on the road to Linkville.

Solano County. Southwestern part.

Sonoma County. Santa Rosa Valley.

IONITE—Described in fourth annual report, occurs in at least four localities, in Ione Valley, the original locality, and in San Benito County at the Coal Mine Mountains, east of Soledad. Among the asphaltum beds at Sargent's ranch, Santa Clara County, and in Los Angeles County near Petrólia, it seems to be some obscure pseudomorth after petroleum and to have a common origin.

LIME—see Calcite.

LIME GARNET—see Grossularite.

LIMESTONE—see Calcite, and special paper on Rocks and Building Stones.

86. LIMONITE. Limonite is rather an abundant mineral in California, being found in numerous localities with other iron ores in the State. The following are the principal and most important ones:

Alameda County. Five miles from the town of Alameda.

Calaveras County. Between Jenny Lind and Campo Seco, San Andreas, near the Big Trees, Sheep Ranch District, near Murphy's.

El Dorado County. Near Latrobe. For description, see Catalogue No. 4148.

Placer County. Forest Hill. In nodules resembling coprolites.

San Luis Obispo County. Harrington Iron Mine, on subdivision of Rancho Cañada de los Osos.

Santa Clara County. With psilomelane.

Shasta County. Iron Mountain Mine, seven miles from Shasta.

Sierra County. At or near Gold Lake.

Solano County. Shores of the bay, in nodules.

Tulare County. Twenty-five miles from Visalia.

YELLOW OCHRE—

Calaveras County. Near Campo Seco.

El Dorado County. Twelve miles northeast of Shingle Springs, section thirty-two, township twelve north, range eleven east, four miles east of Georgetown.

San Diego County. Two miles from Elsinore.

Santa Clara County. Near the Mission of San José.

87. LINARITE. Cupreous sulphate of lead, cupreous anglesite.

This mineral, at first mistaken for azurite, is found in considerable abundance in the silver lead mines of Cerro Gordo, Inyo County, and at the Modoc Mine, in the same county. Some of the specimens obtained are very beautiful.

88. LITHARGE. This substance has been found in San Bernardino County. It is probably a furnace product, made in prehistoric times. It has been found also in Arizona, in localities remote from the Missions, and under circumstances leading to the opinion that the furnaces, now obliterated, were erected and worked by the people who dug the irrigating canals,

and built the Casa Grande, in the valley of the Gila River, and lived in the ancient cliff dwellings.

Lithographic Stone—see Calcite.

89. LITHOMARGE. A fine grained hydrous silicate of alumina, probably sedimentary. It contains generally magnesia and lime. Specimen No. 423, in the State Museum, is from the Alpha Mine, Table Mountain, Tuolumne County; called "pipe clay;" No. 2515 is from near the Big Trees, Calaveras County; and No. 4498 from Lassen County.

Loadstone. Natural magnet—see Magnetite.

Macle—see Andalusite.

Magnesian Limestone—see Dolomite.

90. MAGNESITE. Carbonate of magnesia. Magnesite is a valuable mineral, found in numerous localities in our State. None has, as yet, been put to practical use. The market has been generally supplied from Greece. It is exported to England to the extent of from one thousand to two thousand tons annually. It is sold for thirty-two drachms (about $5 44) per ton. It is used in England for the manufacture of sulphate of magnesia. A small quantity goes to Austria, and is used in the manufacture of hydraulic lime, and a smaller quantity to France, where it is used in the manufacture of firebrick and tiles. The California mineral will be turned to account at some future time, when it will be interesting and important to know where it may be found. The known localities in the State are as follows:

Alameda County. Mount Diable Range, thirty miles south of the mountain.

Mariposa County. A heavy bed of magnesian rock, chiefly magnesite, charged with crystals of iron pyrites, accompanies the chief gold-bearing quartz vein of this county. The rock is charged also with nickel and chrome talc in green films, like the magnesite of Canada.

Monterey County. On Arroyo Seco, in a vein two feet wide. The mineral contains also silica.

Napa County. Township nine north, range five west, M. D. M.

Placer County. At Gold Run and Damascus, said to exist in large quantities.

San Luis Obispo County. At Port Harford.

Santa Clara County. On Coyote Creek, about two miles from Madrone Station, Southern Pacific Railroad, a large deposit of excellent quality.

Tulare County. Near Visalia, below Four Creeks and Moore's Creek, in solid beds of pure white massive mineral. Hard, fine-grained like unglazed porcelain. The beds are from one to six feet thick, interstratified with serpentine and talcose slates. South side of Tule River, ten miles from Portersville.

Tuolumne County. Associated with gold-bearing quartz veins and serpentine.

An artificial carbonate of magnesia is obtained as a by-product in the tanks in working the mother liquors, from the manufacture of salt by the Union Pacific Salt Company, Alameda County, and largely used in the manufacture of explosives.

Magnetic Pyrites—see Pyrrhotite.

Magnetic Sands—see Magnetite.

91. MAGNETITE. Magnetic iron ore.

Magnetite is a valuable ore of iron, and exists with other ores in numerous localities in California. The following are known localities:

Amador County. Two miles northeast of Jackson, magnetic sand, with pyrite; Sutter Creek.

Butte County. With native copper, in the Lincoln Tunnel; Ball Creek, near Oroville.

El Dorado County. Volcanoville (Blake); crystals in slate, near Boston Copper Mine, and with quartz and pyrite, Excelsior Copper Mine (Blake); two miles northwest of Shingle Springs; near Big Red Ravine, two miles from Coloma; Clarksville.

Fresno County.

Inyo County. Magnetite is found in a number of localities in the Inyo Mountains. Fine specimens of loadstone have lately been sent to the State Mining Bureau from the Slate Range, where it exists in quantity.

Los Angeles County. In the Cañada de las Uvas there is a vein, three feet thick, in limestone (Blake); also, thirty miles north of Los Angeles.

Mariposa County. East of the Mariposa estate (Blake); near Coulterville; base of Mount Hoffman.

Mendocino County. Six miles from Calpella.

Mono County. In a vein, five miles south of Benton, with steatite and gold (Aaron); Indian District. Analysis by Falkenau & Reese: Peroxide of iron, 93.00; silica, 7.00; total, 100.00; graphite and sulphide of copper, traces. Near Benton. Analysis by Falkenau & Reese: Peroxide of iron, 93.00; silica, 7.00; traces of sulphide of copper. This ore is said to be in very large quantities. Loadstone. Spur of White Mountains, half a mile south of Montgomery (Aaron).

Napa County. Near St. Helena.

Nevada County. Magnetic sands with gold and pyrite, concentration from hydraulic mines, Grass Valley.

Placer County. Utt's Ranch (Blake); near New England Mills; six miles from Auburn, large deposit: section fifteen, township thirteen north, range eight east.

Plumas County (after pyrite). Armentine Mine, with epidote and garnet (Blake); Mumford's Hill (Edman); near Gold Lake, line of Plumas and Sierra Counties; with hematite, near Crescent Mills.

San Benito County. Tres Pinos; Coast Range Mountains; fourteen miles from Hollister, in large quantities with limestone.

San Diego County. Eight or nine miles north of Mesquit Station.

Santa Barbara County (Trask).

Santa Cruz County. Near the town is an extensive bed; the needle deflected 31° on approaching it (Trask).

Shasta County. At Iron Mountain, five miles from the Sacramento River. Altitude above river, thirteen hundred feet. An abundance of wood at $2 50 per cord and plenty of water at the mine. Analysis by Kellogg, Hewston & Co.: Protoxide of iron, 11.58; sesquioxide of iron, 80.15; alumina, 1.69; silica, 4.95; water, 1.63. McCloud River; Potter's Iron Mine, seven miles from Shasta; in octahedral crystals, exact locality not known.

Sierra County. In large beds (Blake); Mohawk Valley, Sierra Iron Company.

Sonoma County. Mouth of Russian River; magnetic sands.

Trinity County. Near Weaverville (Trask).

Yuba County.

92. MALACHITE. Green carbonate of copper, mountain green. This mineral occurs with other ores of copper at numerous localities in the State.

Calaveras County. In remarkably fine specimens, with crystals of azurite, at Hughes' Mine (Blake); at Copperopolis.

Del Norte County. Low Divide.

Inyo County. At numerous localities in the Inyo and Coso Mountains.

Kern County. San Emidio Ranch, with melaconite.

Mono County. With azurite, cuprite, and partzite; Kerrick Mine, Blind Springs.

Plumas County. With azurite, gold, and quartz.

San Diego County. With azurite, cuprite, and chrysocolla; Lost Mine, thirty miles west of Colorado River.

San Luis Obispo County. Santa Rosa Creek.

Shasta County. Peck Mine, Copper Hill.

Tuolumne County. Whitman's Pass.

MALTHA—see Petroleum.

MANGANESE OXIDE—see Pyrolusite.

93. MARIPOSITE. This is a mineral of an apple green color, found with quartz, on the Mariposa estate, Mariposa County, and elsewhere on the great mother lode of the State. It has not yet been fully determined. It is referred by Dana to fuchsite. It was first described by Professor Silliman, December 2, 1867: see proceedings of the California Academy of Sciences, vol. 3, folio 380. It is represented in the State Museum by a single specimen, No. 1295, from the Josephine Mine, Mariposa County.

Quartz containing mariposite has been shipped to China from Mariposa County in considerable quantity, which mineral was the valued one is not known; as mariposite has a pleasing green color it has been thought that the Chinese either mistook it for jade or used it as a substitute.

MARBLE—see Calcite and special paper on Building Stones.

94. MARCASITE. Sulphide of iron, white pyrites. This mineral has the same composition as pyrites, but is of a white color. It is put to the same uses, such as making sulphur, sulphuric acid, etc. It is quite common as an associate of gold in California with pyrite (yellow colored), chalcopyrite, galena, sphalerite, mispickel, etc.

95. MELACONITE. Black oxide of copper. This is a rare mineral in California. It is said to occur with malachite at the San Emidio Ranch, Kern County, and in the Afterthought Mine, Shasta County. Melaconite occurs in the Satellite Copper Mine, formerly the Lancha Plana, near Campo Seco, Calaveras County, in masses of considerable size, with bornite, and containing granules of metallic copper the size of bird-shot. In the R. F., with chloride of ammonia it imparts an intense blue color to the flame. It is partly soluble in hydrochoric acid. The mineral occurs in nodules, black and earthy inside, but covered with a white incrustation.

96. MENACCANITE. Ilmenite, titaniferous iron. A single but fine crystal was found in the gold washings near Georgetown, El Dorado County. It was about an inch in diameter, with brilliant planes (Blake). Fine specimens are brought from Bill Taylor's Ranch, near Buchanan, Fresno County, twenty miles southeast of Mariposa.

97. MERCURY. Native mercury is found in many of the quicksilver mines in the State, but never in large quantities. It always occurs near

the surface of the earth, above active mines in which cinnabar has formed and is still forming. Sometimes a soft rock overlying the mines, the nature of which has not been properly studied, on being broken open is found to be permeated by native mercury in minute globules. Under the head of cinnabar the production of quicksilver in the State is given.

98. METACINNABARITE. This rare mineral is a black sulphide of mercury, described by G. E. Moore in 1870. It resembles cinnabar in composition, being like that species (Hg S), but differs from it in color, streak, specific gravity, and luster. It corresponds to the black sulphide of mercury, produced artificially by mixing the elements; while cinnabar conforms to the artificial sulphide obtained by sublimation. It occurs with cinnabar and native mercury in several quicksilver mines in California, and has lately been found in Oregon. It has never been obtained in large quantities like cinnabar, and is still considered a rare mineral. When first found it was generally thought to be amorphous, but it has since been found beautifully crystallized in the Redington Mine, Napa County, the locality where it was first discovered. Fine specimens have been obtained in the Great Western Mine, Lake County; in the California Mine, Yolo County, amorphous and in crystals.

99. METEORIC IRON. In 1866 Dr. Trask found a small fragment of iron in Honcut Creek, Butte County. It had the appearance of cast-iron, and was pronounced by Professor Brush not to be meteoric. Still it was considered remarkable at the time, that a fragment of cast-iron should have been found under the circumstances, and it is a little singular that a similar fragment has been recently sent to the State Mining Bureau, which was found on the bedrock, near Columbia, Tuolumne County. At a meeting of the California Academy of Sciences, February 19, 1866, Professor J. D. Whitney stated that Dr. J. G. Coffin had found fragments of iron in the bed of the Mohave River. At that time no meteorite had been found in California that was known to be such.

There was a rumor, a number of years ago, that there was a large mass of meteoric iron on the line of travel up the coast, a few miles north of Crescent City, Del Norte County, but it could never be traced to any reliable source. The El Dorado meteorite was found at Shingle Springs, by a blacksmith whose name is not given. It was noticed by J. H. Crossman in 1871, and placed in the cabinet of W. V. H. Cronise, where it was seen and described by Professor B. Silliman, in the *American Journal of Science and Arts* for July 18, 1873, with a figure from a photograph by Watkins of San Francisco. A short notice of it by Professor C. U. Shepard of Amherst College, appeared in the same journal of June, 1872. The weight of this meteorite was about eighty-five pounds avoirdupois. Its largest dimensions were twenty-four and twenty-nine centimeters; density, 7.875. No Widmannstattian figures were developed by etching.

The following analysis of it by J. A. Cairns, of the School of Mines, Columbia College, New York, is published:

Iron	81.480
Nickel	17.173
Cobalt	.604
	99.257

With the following elements in small proportions: aluminum, calcium, carbon, chromium, magnesium, phosphorus, potassium, sulphur.

Professor Shepard arrived at quite different results, viz.:

Iron	88.02
Nickel	8.88
Insoluble	3.50
	100.40

This meteorite still remains in San Francisco.

The *San Bernardino Meteorite*, No. 2339, State Museum, was found in 1880 in the Ivanpah Mining District, San Bernardino County, by Stephen Goddard. The weight, before cutting, was 1,870 troy ounces. Dimensions: length, 13.5 inches; width, 9.7 inches; thickness, 8 inches. Specific gravity of the mass, 7.693. It is an irregular body or mass of malleable iron. The surface is covered with concave cup-like depressions, some of which have considerable depth. The fine Widmannstattian figures on the cut face were developed by the action of nitric acid, and the smooth rim or border was protected from the action of the acid by wax, and should not be mistaken for a crust or outer shell. On one end of the aerolite may be seen distinct crystals corresponding to those developed by acid. Photographs, on a scale of one third the actual size, were taken of this specimen, both before and after cutting. Lithographs from these photographs were published in the fourth annual report. The following analysis was made in the University of California by Mr. Gustav Gehring:

University of California, Berkeley, May 17, 1884.

Analysis of the San Bernardino Meteorite, by Gustav Gehring, Assistant in Chemistry in the University of California:

Iron	94.856
Nickel	4.469
Cobalt	.261
Silica	.041
Sulphur	.004
Phosphorus	.002
Carbon in combination	.115
Graphite	.067
	99.815

Hardness, 3.75; specific gravity, 8.076.

100. MICA. Isinglass, muscovy glass, etc. See also biotite. Muscovite is abundant in the granite rocks of the State.

The following include the principal localities at which this mineral has been found in California: At Gold Lake, Plumas County; in El Dorado County; Ivanpah District, San Bernardino County; near Susanville, Lassen County; and at Tehachapi Pass, Kern County; it having been observed at many other places in the State. As little or no work has been done on any of these deposits, not much can be said in regard to their probable value, one way or the other. We have reports of mica being found in nearly all the Pacific States and Territories; also in those contiguous to the Rocky Mountains; its occurrence in some of these being abundant, and extending to many different localities.

Micaceous Iron—see Hematite.

101. MILLERITE. Sulphide of nickel. This mineral is brass-yellow, resembling chalcopyrite. It is not a common or abundant mineral, and in California has been observed only at one locality, half a mile from Cisco, Placer County.

Mineral Coal—see Lignite.

MINERAL WATERS—see special paper on this subject elsewhere.
MISPICKEL—see Arsenopyrite.

102. MOLYBDENITE. Sulphide of molybdenum.

This is a soft, black, lustrous, foliated mineral, resembling graphite, for which it is frequently mistaken. It has no special value. It is rather common in California, in the granites of the Sierra Nevada, and associated with gold in the quartz veins, and frequently with copper and silver ores.

The following are the most important localities in the State. Most of them are represented in the State Museum:

El Dorado County. Cosumnes Copper Mine, with ores of copper.

Fresno County. Speckerman's Mine, Fresno Flat.

Inyo County. Beveridge Mine; foliated; mistaken for graphite; near Independence.

Nevada County. Excelsior Mine (Dana).

San Diego County. At Campo.

Tulare County. South Fork of King's River, forty-five miles northeast of Visalia.

103. MOLYBDITE. Molybdic acid, molybdic ochre, molybdine.

According to Dana, this mineral is found in the Excelsior Mine, Nevada County, with molybdenite and gold.

MOUNTAIN BLUE—see Azurite.
MOUNTAIN BUTTER—see Lenzinite.
MOUNTAIN CORK—see Amphibole.
MOUNTAIN LEATHER—see Amphibole.
MUNDIC—see Pyrite.
MUSCOVITE—see Mica.
NATRON—see Trona.

104. NICKEL ORES. See also Millerite and Zaratite.

Dr. Trask, in his first "Report on the Geology of the Coast Mountains, and part of the Sierra Nevada, 1854," refers to nickel ores, "in the Coast Mountains from Contra Costa to the utmost limit reached in that range, associated with chromic iron in primitive rocks. The mineral is more abundant in the serpentine rocks south of Tularcitos, and near San Antonio, Monterey County." This mineral, zaratite, or "emerald nickel," will be described under the proper head.

NITRATE OF SODA—see Soda Niter.
OBSIDIAN—see Orthoclase.
OCHRE—see Limonite.
ONYX MARBLE—see Aragonite.

105. OPAL. Hyalite, wood opal.

Only the inferior varieties of opal are known in California, and these only at a few localities, as follows:

Alameda County. With semi-opal in Mount Diablo Range, thirty miles south of the mountain (Blake).

Amador County. At Volcano (Hyalite).

Calaveras County. A white milky variety of opal is found in Calaveras County, at Mokelumne Hill, or on the hill near that place known as Stockton Hill, on the west side of Chile Gulch. A shaft has been sunk there three hundred and forty-five feet, and the opals are found in a thin stratum of red gravel. They vary in size from a kernel of corn to the size of walnuts. Many of them contain dendritic infiltrations of manganese

oxide, looking like moss. About a bushel of these stones are raised in one day, and are said to have a market value. A white, milky variety similar to the above, and without "fire," is found with magnesite in the Mount Diablo Range, thirty miles south of the mountain. Also in the foothills of the Sierra Nevada, at the Four Creeks (Blake).

This locality is represented in the State Museum by No. 4395. They are also found near Murphy's, Calaveras County (Dana).

El Dorado County. Nine miles northeast of Georgetown.

Lake County. Kelseyville—hyalites found plentifully in cavities in basaltic lava, township ten north, and ranges five and six east.

San Bernardino County. (Hyalite). Hyalite resembles glass, and is generally found in irregular fragments. Opalized wood is wood petrified and changed to opal. It is not uncommon in the hydraulic gold mines, in magnificent specimens.

Osmium—see Iridium, with which it is invariably alloyed or associated.

Opalized Wood—see Opal.

106. ORTHOCLASE. Feldspar, common feldspar, potash feldspar, obsidian.

Orthoclase, and obsidian, a variety of the same mineral, are found in numerous localities in California.

Fresno County. (Orthoclase), near Millerton, in coarse granite.

Inyo County. (Obsidian), with basaltic lava.

Kern County. (Orthoclase), in veins several feet thick, Tehachapi Pass.

Lake County. (Obsidian). When first discovered, years ago, at Clear Lake, in Lake County, a company was formed to make bottles and other glassware from it, but the enterprise was of course a failure.

Near Lower Lake, in fine specimens—black, gray, red, and variegated.

Lassen County. (Obsidian), found in great abundance on the east side of Eagle Lake, a mile, more or less, from Clark's Ranch. It is found scattered over the surface and in the soil with a porous, redish colored lava.

Mariposa County. (Orthoclase), in veins in granite, with molybdenite, in Yosemite Valley.

Modoc County. (Obsidian), south end of Goose Lake.

Mono County. (Obsidian), McBride's Ranch, near Mono Lake, in and at the base of volcanic cones.

Napa County. (Obsidian), three miles west of Napa.

Plumas County. (Orthoclase), at Meadow Valley.

San Diego County. (Orthoclase), Hunsacker Grade, stage road from San Diego to Julian, in considerable quantities and suitable quality for the manufacture of fine pottery. It is associated with pegmatite, also useful for the same purpose; near the Owens Mine, Julian, in coarse granite. Some varieties of obsidian cut beautifully, and might be used for ornamental purposes, for paper weights, vases, bases of clocks, and similar purposes.

Osmium—see Iridium, with which it is invariably alloyed or associated.

Pandermite—see Priceite.

Partzite—see Stibiconite.

Pearl Spar—see Dolomite.

107. PECTOLITE. A single specimen was found in a bowlder or fragment at the foot of the White Mountains, near Montgomery, Mono County. Doubtful (Aaron).

108. PETROLEUM.

Under this heading also *asphaltum*, *maltha*, *brea*, *idrialite*, *bitumen*, *aragotite*.

For special paper on this subject see fourth annual report, folio 278.

Petroleum has been found in the following counties in this State, viz.: Alameda, Colusa, Contra Costa, Humboldt, Kern, Lake, Los Angeles, Mendocino, Napa, San Bernardino, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Sonoma, Tulare, and Ventura.

The most important localities are given below; for details of the occurrence see fourth annual report.

PETROLEUM—

Alameda County. Near Midway.

Los Angeles County. In Pico Cañon, near Newhall, where there are numerous wells which yield very large quantities; at Puenta; at Petrolia, near the latter, on section five, township three south, range nine west, since my visit in May, 1884, flowing wells have been struck. In October, 1885, in sinking a well in Cahuenga Valley, a flow of petroleum was struck, which according to the Los Angeles *Evening Express*, it was impossible to check.

San Mateo County. At Tunitas Creek, several wells which have produced excellent light oil.

Santa Barbara County. Oil springs under the ocean; oil seen floating on the surface of the sea; these oil springs have been described elsewhere in this report.

Santa Clara County. At Moody Gulch—extensive works—considerable high grade oil produced.

Ventura County. At Santa Paula, where large receiving tanks have been provided.

ASPHALTUM AND MALTHA—

Kern County. Near Buena Vista Lake and elsewhere, in large quantities.

Los Angeles County. La Bréa Ranch, near Los Angeles.

San Luis Obispo County. Coral de Piedra.

Santa Barbara County. Goleta Landing, seven miles west of the town of Santa Barbara, on Laguna Santos and Los Alamos Ranchos, near Carpenteria.

Santa Clara County. Sargent's Ranch, in large quantities.

Ventura County. Oil wells near Sulphur Mountain, Santa Ynez, and Kayamos Valleys, near Mission of San Buenaventura.

ARAGOTITE—

This mineral, a hydro-carbon, was found by F. E. Durand, in the New Almaden Quicksilver Mine, and, so far as known, is peculiar to the quicksilver mines of this State.

109. PETZITE. This mineral is a telluride of silver and gold. It is of too rare occurrence in California to have any practical value aside from the gold it contains, and interesting only as being an associate of gold.

An analysis of a specimen from the Stanislaus Mine, Calaveras County, afforded Kustel:

Tellurium	35.40
Silver	40.60
Gold	24.80
	100.80

While this analysis shows the mineral to be rich in gold, it is so rare that only very small specimens can be obtained, and these but seldom. It

occurs with the other tellurium minerals which constitute but a very small portion of the vein matter.

The following localities are known: Stanislaus and Melones Mines, in Calaveras County; Morgan Mine, Tuolumne County.

110. PHOSGENITE. Chloro-Carbonate of Lead.

A single specimen has been found in quartz from the Silver Sprout Mine, western slope of the Sierra Nevada, Inyo County. Straw-colored, acicular interlaced crystals in cavities (Aaron). Determination by C. Ide.

PHOSPHATE OF LIME—see Apatite.

111. PICOTITE. Chrome spinel.

Has been found by Dr. M. E. Wadsworth in the basalts of Mount Shasta; "Summary of the Progress of Mineralogy in 1882," H. C. Lewis.

PICROLITE—See Serpentine.

PLATINIRIDIUM—See Platinum and Iridium.

112. PLATINUM—See, also, Iridium.

Platinum is rather abundant in California with other metals of the group. The miners call it "white gold," and generally believe it to be more valuable than that metal, generally declining to save it when informed that it can only be sold for two or three dollars per ounce.

The following are the most important localities:

Butte County. Platinum minerals are rather abundant in this county. Considerable quantities are recovered in the clean-ups at the Spring Valley hydraulic mine. At St. Clare Flat near Pence, large quantities were found in the early days of placer mining.

Mendocino County. With iridium, cinnabar, zircons, and gold, Anderson Valley, on the Navarro River.

Plumas County. Mr. A. Hewett found several large pieces of platinum in 1851 on Nelson Creek. The largest was the size of a large bean. It is found also at Gopher and Badger Hills.

Trinity County. Found with iridium and associated metals and minerals, and in considerable quantities, at Hay Fork, a large stream. All the gold found is more or less mixed with the platinum metals; so much so that dealers deduct two dollars per ounce from the price paid elsewhere for gold dust. At North Fork of Trinity River, platinum is found in less quantities, but in larger pieces. One was once offered for sale in Marysville which weighed over two and a half ounces troy.

Although platinum occurs in the river beds, and on the banks of the streams, yet in the so called "hill claims," about half a mile only from the river, no trace of that metal has been found. In lower Trinity, near its junction with the Klamath, platinum abounds in very fine particles; and it is with this finely divided platinum that Professor Wöhler discovered diamonds.

The metal is so abundant that the miners have the utmost difficulty in separating it from the gold. The particles are so extremely fine that they can hardly be distinguished from the black sand which accompanies the gold. Heretofore no effort has been made to place the platinum in the market, except the sending to San Francisco of one hundred ounces or more, a few years ago. It could, probably, be sent to Europe to advantage. In Salmon River it is also found. In fact, it is common in the beds of the streams in Sierra, Trinity, Klamath, and Del Norte Counties.

Mr. Block of San Francisco, said that large pieces have been found on North Fork of Trinity River; one piece weighed two ounces. The miners

in washing gold in long sluices got the gold by the aid of quicksilver, and the platinum minerals remained in the riffles; with platin-iridium, in a claim three miles from Trinity Center; and with gold zircons, diamonds, and other minerals on the ocean beach, from Cape Blanco to Cape Mendocino.

Dr. S. R. Hayden, now of Chicago, was at Rich Bar, North Feather River, in 1851. He found in a placer mine he was working a piece of white metal, very heavy, about three inches long, two inches wide, and about half an inch thick, which he thinks must have been platinum.

113. POLYBASITE. A sulphide of many bases, viz.: antimony, arsenic, copper, iron, silver, and zinc.

It is a rare mineral in California, being found only in small microscopical crystals in the Morning Star and Monitor Mines, Alpine County.

114. PRICEITE. Borate of lime, pandermite, colemanite, etc.

The variety pandermite has recently been found in apparent abundance in Death Valley, Inyo County, and at Calico, San Bernardino County, and the cryptomorphic variety also at the latter locality.

Colemanite—

Is also a variety of priceite found recently in Death Valley in a crystalline state. As this mineral possesses certain physical properties differing from priceite, a name has been given to it to distinguish it from the soft chalky mineral found both in southern Oregon and San Bernardino County, California.

The name *colemanite* was given by the discoverer of the mineral in honor of William T. Coleman of San Francisco, who has been identified with the borax interests of the Pacific Coast from the commencement. Colemanite is now found in magnificent crystals, but good crystallized specimens are very scarce.

115. PROUSTITE. Light ruby silver ore.

Arsenical sulphide of silver, found sparingly in the Chicago Mine, Shasta County, with galena, pyrite, and quartz, between walls of granite (Aaron). No. 4951, in the State Museum, from the Oro Mine, Bodie, Mono County, shows it in crystals, with pyrargyrite in quartz.

116. PSILOMELANE. A hard black mineral, supposed to be psilomelane, is found in several localities in the State, with pyrolusite and rhodonite, but no analysis has been made to prove it. This mineral differs from pyrolusite in containing baryta and oxide of manganese, and more water. It has been found at Spanish Ranch, Plumas County, on Red Rock, Bay of San Francisco, and in quartz, Santa Ana River, Los Angeles County.

Pumice Stone—see Orthoclase.

117. PYRARGYRITE. Dark ruby silver, antimonial sulphide of silver.

This mineral, like proustite, is rare in California. It has been found in the Exchequer Mine, Alpine County, and with proustite, in the Oro Mine, Bodie, Mono County.

118. PYRRHOTITE. Magnetic pyrites.

Found in Mariposa County, at the Iona Copper Company's tunnel, north side of the Merced River, on the trail from Bear Valley to Coulterville (Blake).

119. PYROLUSITE. Binoxide of manganese.

The known California localities are:

Alameda County.

Calaveras County. Near Angels': Railroad Flat.

Colusa County. About two miles south of Font's Springs, township seventeen north, range seven west.

Contra Costa County. Corral Hollow—abundant.

Marin County. Near Saucelito and Tomales.

Napa County. St. Helena Mountain.

Nevada County. Sweetland.

Plumas County. Argentine, and Mumford's Hill (Edman).

San Bernardino County. With rhodonite, near Colton.

San Francisco Bay. Red Rock, San Francisco County; Bernal Heights, San Francisco; just south of St. Mary's College, Peninsula of San Francisco.

Santa Clara County. Hahn's ranch, twelve miles south of the Guadalupe Quicksilver Mine.

Sonoma County. Near Cloverdale; Santa Rosa.

Tuolumne County. Knight's Ranch, near Columbia, in botryoidal and mammillary masses, from the size of a grape to one hundred pounds in weight, on the surface of the ground: with rhodonite, two miles south of Summerville.

120. PYRITES. Pyrite, sulphuret of iron, the "sulphurets" of the gold miner, mundic, martial pyrites. See, also, Marcasite.

Of the numerous localities of pyrite in the State, the following are worthy of special mention, or are represented in the State Museum:

Alpine County. Morning Star Mine, with enargite.

Amador County. Jackson.

Calaveras County. E Pluribus Unum Mine, three miles from Murphy's (Blake).

El Dorado County. Brilliant cubes, Mameluke Mine, near Georgetown (Blake); Pilot Hill, in large cubes, with garnet-brown spar and specular iron (Blake): in crystals with gold, with quartz, both crystallized.

Inyo County. Modoc Mine.

Mariposa County. In slates, in large and perfect crystals, near Princeton Hill (Blake).

Mono County.

Napa County. With cinnabar. Redington Quicksilver Mine, very fine; in cavities in quartz, cubical crystals, Knox & Osborn Quicksilver Mine.

Nevada County. Grass Valley, massive, with chalcopyrite, San Francisco copper mine, Spenceville; massive, with gold, Meadow Lake District; taking the form of wood, with hematite, Occidental Mine, Scott's Flat; with calcite, Malakoff Mine, North Bloomfield; in lignite, Malakoff Mine, North Bloomfield.

Placer County. Globular, in calcite, near Auburn; Clipper Coal Mine, near Grizzly Bear House, Forest Hill, in large crystals (Blake); True Fissure Mine, Devil's Peak Mountain; with lignite, Spinks' Coal Mine, Lincoln.

Plumas County. Granite Basin, Mumford's Hill, in crystals, with dolomite (Edman).

San Luis Obispo County. In cavities in the Sunderland Quicksilver Mine.

Shasta County. With pyrolusite and gold, Banghart Mine; with erube-

seite and chalcopyrite, Copper City; in nodules, with sulphide of silver, very rich.

Tuolumne County. In fine crystals, Patterson Mine, Tuttletown.

121. PYROPHYLLITE. This mineral, a hydrous silicate having no economic value, but which is interesting from a scientific standpoint, is found in beautiful radiating tufts of a golden yellow color, at Greaser Gulch, or Indian Gulch, Mariposa County. It occurs in large bowlders on the surface of the ground near two prominent buttes. This locality is represented by No. 3723 in the State Museum.

122. PYROXENE. A silicate of different bases, the varieties of which are known under different names, as augite, diopside, sahlite, omphazite, hypersthene, diallage, smaragdite, etc.

This mineral enters largely into the composition of igneous rocks. In this form it is probably largely distributed in California. It is found in fine dark green crystals near Mud Springs, El Dorado County (Blake), and also in fine crystals at the Cosumnes Copper Mine, in the same county.

123. QUARTZ. The varieties are known by many names, among which are agate, amethyst, aventurine, blood stone, Brazilian pebble, buhr stone, carnelian, cat's-eye, chalcedony, chrysoprase, cairngorm, false topaz, heliotrope, jasper, mocha stone, onyx, prase, quartz and quartzite, rock crystal, siderite, silicified wood, sardonyx, etc.

Quartz is very abundant in California. It forms the principal vein matter in the gold mines, associated with blende, galena, chalcopyrite, freibergite, bornite, mispickel, pyrite azurite, and malachite, scheelite calcite, caproscheelite, dolomite, enargite, and other minerals. It would be impossible and unnecessary to enumerate all the known localities in the State. The following are the most important and interesting. The massive quartz found almost universally where the rocks are not covered with soil, is not included:

Alameda County. Hills back of Berkeley, *chalcedony.*

Alpine County. Monitor, *red jasper.* Sonora Trail, *chalcedony.* Morning Star Mine, *quartz.* Hope Valley, *rose quartz*, massive, very fine; *drusy crystals.*

Amador County. Near Volcano, *chalcedony, silicified wood.* Ione Valley, *diatomaceous earth.*

Butte County. North Fork of Feather River, *smoky.* Near Doon's Mill, *crystals*, fine, and *chalcedonic pebbles.* Three miles south of Cherokee Flat, Gold King Mine, with quartz, *sacchroidal quartz*, like that in the gold mines of Georgia and Brazil.

Calaveras County. Mokelumne Hill, *silicified wood.* In the gold mines, croppings, or "iron hat," *red jasper.* Murphy's, *brown jasper*, which polishes beautifully; *cat's eye.* Vallecito, *chalcedony.* Chili Gulch, Duryea's Hydraulic Mine, *silicified wood.* Near Comanche, *diatomaceous earth.* Murphy's, *chalcedony.* Near Angel's Camp, *silicified wood.* Dutch Flat, in hydraulic mines, *silicified wood*, very fine. Roseville, *silicified wood.*

Contra Costa County. Mount Diablo Coal Mine, with lignite, *silicified wood.*

Del Norte County. Crescent City beach; *chalcedony, jasper, carnelian, agate.*

El Dorado County. Summerfield, Mosquito Cañon, near Placerville; *cairngorm, rock crystal, smoky quartz* in crystals six inches in diameter (Blake).

Fresno County. Fresno Flat, *yellow granular quartz* containing gold, resembling that found in the gold mines of Georgia. The gold is remarkably fine.

Inyo County. Eclipse Mine, *chalcedony;* very fine. Beveridge District, *double terminated crystals, smoky quartz.* Modoc Mine, in beautiful forms. Panamint, colored with malachite. Wyoming Mine, in fine large clusters of crystals; very fine. Small Butte, in Owens Valley, *buhrstone;* good quality.

Lake County. Eclipse Mine, seven miles west of Lower Lake, *silicified wood.* Lost Spring Ranch, *diatomaceous earth.*

Los Angeles County. Between Williamson's Pass and Johnson's River, *chalcedony* in pear-shaped nodules in eruptive rocks (Blake). Santa Monica, *diatomaceous earth.* Fourteen miles south of San Pedro, *diatomaceous earth.*

Marin County. Saucelito, *jasper;* red and green.

Mariposa County. Merced River, between Horse Bend and Don Pedro Bar, *oil stone,* or novaculite, discovered in 1866, and said to be of good quality. Pine Tree Mine, *hacked quartz;* a peculiar variety of quartz which has a resinous luster and containing mariposite, has been shipped to China, said to be used in the manufacture of porcelain. There were four shipments of three to four tons each.

Modoc County. Jess Valley, *bloodstone.* Pit River, near Goose Lake, *buhrstone* in great abundance (Trask).

Mono County. Mono Lake, *silicified wood.* Bodie Mines, on silver ore in fine crystals, *chalcedony,* pink and straw colored, very fine; *hornstone.*

Monterey County. Monterey, on the beach; quartz sand, much employed for glass-making and other purposes; near Panoche's, large masses of *chalcedony;* white and delicately veined; in mammillary sheets; *diatomaceous earth* in numerous localities.

Napa County. Manhattan Mine, with cinnabar and stibnite, *chalcedony;* Mount St. Helena, *silicified wood;* near Calistoga, *silicified wood;* near St. Helena, *jasper, chalcedony.*

Nevada County. In the gold mines; often supporting native gold between the crystals (Blake); Hinchman's hydraulic mine, *quartz breccia;* Malakoff Mine, *quartzite;* Omega, *silicified wood;* Chalk Bluffs, *silicified wood* in many varieties in the hydraulic mines.

Placer County. At Lincoln, in beds several feet in thickness, *quartz sand,* very pure and white. *Silicified wood* at a number of localities. Dutch Flat, *diatomaceous earth.* Forest Hill, *silicified wood.* Gold Run, *silicified wood.* Shores of Lake Tahoe, *carnelian, agate.*

Plumas County. *Rose quartz,* fine. Claremont's Hill and Mumford's Hill, *jasper.* Long Valley and Spanish Creek, *agate.* Granite Basin, *quartz crystals,* very fine.

San Bernardino County. Soledad Cañon, *chalcedony.*

San Diego County. Seacoast, forty miles north of San Diego, *diatomaceous earth.* Big Tank, Colorado Desert, *silicified wood, chalcedony.*

San Francisco County. *Jasper,* red and green. On the seabeach, *quartz sand* with magnetite.

San Joaquin County. Staples' ranch and San Carlos ranch, *diatomaceous earth.*

San Luis Obispo County. *Agate, silicified wood.* Port Harford, *diatomaceous earth.*

San Mateo County. *Chalcedony, jasper;* Pescadero beach, *carnelian, agate, chalcedony;* San Gregorio, *diatomaceous earth.*

Santa Barbara County. *Diatomaceous earth.*

Santa Cruz County. Ranch of Harry Love, near San Lorenzo, there is said to be a mountain of *white quartz sand.*

Shasta County. *Hacked quartz* with gold.

Sierra County. Near Downieville, *silicified wood.*

Sonoma County. Ten miles north of Petaluma, *diatomaceous earth;* Santa Rosa, *silicified wood*; before petrefaction the wood had been pierced by worms; near Windsor, *bloodstone;* eighteen miles southeast of Santa Rosa, *diatomaceous earth.*

Tulare County. Portersville, *silicified wood;* Yokhe Valley, *rose quartz.*

Tuolumne County. Columbia, *silicified wood;* Douglasville, *chalcedony.*

QUARTZITE—see Quartz.

QUICKSILVER—see Mercury.

124. REALGAR. Sulphide of arsenic. This mineral is rare in California, being known only with arsenolite in Alpine County.

RED OXIDE OF COPPER—see Cuprite.

RED OXIDE OF IRON—see Hematite.

125. RESIN. Fossil.

In the hydraulic gold mines of California a fossil resin is frequently met with, which is probably from the coniferous trees of former growth, found in such profusion in a silicified state. It is brittle and resinous, and still retains an odor. It somewhat resembles gum dammar, but is more yellow. It has never been studied.

RETINALITE—see Serpentine.

126. RHODONITE. Silicate of manganese.

It occurs in several localities in the State, always with pyrolusite; with native copper, Mumford's Hill; Plumas County (Edman); one mile from the Southern Pacific Railroad, between Colton and San Diego; near San José, Santa Clara County; two miles south of Summersville, Tuolumne County, in considerable quantity; a large deposit of rhodonite and pyrolusite occurs two miles north of Sonora, Tuolumne County. Rhodonite has little or no economic value.

127. ROCK SOAP. This is a mineral resembling halloysite and mordenite, but believed to be a mechanical mixture of two or more minerals. It has the remarkable property of removing impurity from the skin, like soap, whence the name. There have been numerous analyses made which do not agree among themselves. A paper was published by Professor George H. Koenig, in *The Naturalists' Leisure Hours*, Philadelphia, which is very full and explicit, giving the result of considerable laboratory work. A series of analyses were made in the laboratory of the State University, which have not been published. In Professor Koenig's examination the soapy portion was separated mechanically from a sandy portion and analyzed, with the following results:

Sesquioxides of alumina and iron	14.10
Silica	73.10
Water	6.70
Not determined	6.10
	100.00

Nearly all the silica was found to be in the soluble or opaline state, and the alumina either as a hydrate, or a very basic hydrated silicate. At one time this material was manufactured into a variety of useful articles, as

salt water soap (it having been found that the presence of salt and lime did not impair its detergent properties), scrubbing, and toilet soap, and even tooth powder. Having had occasion to examine into the merits of these preparations, I am prepared to say that they served every purpose claimed for them. At the Paris Exposition of 1878, samples were shown which attracted considerable attention, and there were those who expressed an inclination to enter into their manufacture in France. At present "rock soap" is largely used in the manufacture of certain kinds of soap in California. No. 4024, in the State Museum, is a specimen from Ventura County, and No. 4794 is from San Benito County.

128. ROSCOELITE. Vanadium mica. This very rare mineral was described in the second annual report, folio 262, and a history given of its discovery.

California known localities:

The "Stuckslager," "Plum Tree," or "Sam Simms" Mine lies in section twenty-four, township eleven north, and range nine east, Mount Diablo base and meridian, somewhat more than a mile from the town of Coloma, in a southwest direction, where it was first found.

Another locality of roscoelite in the State, is section thirty-one, township eleven north, and range ten east, two miles from the Sam Simms Mine. Big Red Ravine is on this section, lying only two miles from the site of Sutter's Mill, where gold was first discovered. It was one of the earliest placer mines known in the State, and so rich did it prove, that it has paid to rework as many as seven times. It is in the bedrock of these old workings that roscoelite is found.

Recently a fine specimen of roscoelite has been presented to the State Museum, which is mixed with gold to the extent of seemingly half the bulk of the specimen. It was presented by Richard Sparling and is numbered (5768). It is from the Tip Top vein, section seven, township eleven north, range ten east, El Dorado County. There is about a foot of quartz disseminated through the vein, in small bunches, connected with which are seams of roscoelite, generally very thin, from the thickness of paper to half an inch. Occasionally a bunch of roscoelite appears, from which specimens like No. 5768 may be obtained, but these are extremely rare. Mr. Sparling says that at the Sam Simms Mine, the owners once took out of a pocket $11,000. A great deal of free gold has been washed from the sides of the hill, below the vein, which came, without much doubt, from decomposed roscoelite, and it is more than probable that the gold discovered at Sutter's Mill, in 1848, and that taken from Big Red Ravine, were from the same source. In the Tip Top there is a sheet of what seems to be sandstone; when this and the brown slate come in contact, gold and roscoelite are found.

RUBELLITE—see Tourmaline.

RUBY SILVER—see Pyargyrite and Proustite.

129. RUTILE. Titanic acid. Is found at Long Valley, Plumas County (Edman); and frequently in acicular or capillary crystals in quartz. No. 3747 is a specimen of this character from Humboldt County, Nevada, and there are other specimens in the museum from other localities. Titanic acid has few applications in the arts: it is used in porcelain painting, and to give color to artificial teeth.

SALT—see Halite.

130. SASSOLITE. Native boracic acid.

Boracic acid, free or combined, is a common occurrence on the Pacific Coast. It has been detected in the waters of the ocean along the shores of California and Oregon. Common salt, made by evaporating the sea-water, contains more than traces of boracic acid. According to Professor W. P. Blake, it occurs in a free state in the water of Clear Lake. The discovery of this acid in mineral water in Tehama County led to the examination of other springs then known, which resulted in the finding of boracic acid in nearly all of them. It was found later in the mud volcanoes in San Diego County by Dr. Veatch, which was verified by my own observation.

SATIN SPAR—see Gypsum.

131. SCHEELITE. See also Cuproscheelite, tungstate of lime.

Only one locality is known in the State, the footwall of a gold mine on Howard Hill, Grass Valley, Nevada County, where it is said to occur in considerable quantity.

SCHORL—see Tourmaline.

SELENITE—see Gypsum.

SEMI-OPAL—see Quartz and Opal.

132. SEPIOLITE. Meerschaum, hydrous silicate of magnesia.

A specimen in the State Museum from the Half Dollar Mine, Inyo County, resembles sepiolite, but as yet no analysis has been made to determine it.

133. SERPENTINE. Chrysotile, picrolite, retinalite. This mineral is very abundant in California. Quicksilver and chromium ores are found in it almost universally. The following localities are represented in the State Museum:

Butte County. Near Red Hill. The bedrocks are serpentine; fine specimens of picrolite are found.

Lake County. Kelseyville.

Marin County. Very abundant.

Mariposa County. Three hundred yards northeast of the Pine Tree Mine, and elsewhere in the county.

Mendocino County. Township ten north, range ten west, foliated serpentine and picrolite found in considerable quantity.

Monterey County. Coral de Tierra.

Napa County.

Nevada County. Grass Valley, in the Maryland Mine, picrolite.

Placer County. Bald Prairie; Verde antique or ophite, serpentine with carbonate of lime, has recently been found near Yankee Jim's. It is of a sea-green shade, with blotches of a darker color. It is a beautiful ornamental stone, if it can be found in sufficient quantity. The specimen sent to San Francisco was small.

Plumas County. Claremont Hill, Meadow Valley, retinalite, green and translucent.

San Francisco County. Peninsula of San Francisco, Fort Point, with aragonite; in the streets of San Francisco, Market Street Cut, and the cemeteries.

Santa Barbara County. Goleta.

Santa Clara County. New Almaden Mine, schistose, and in many other quicksilver mines in the State; Gilroy.

Shasta County. McCloud River, with *chrysotile.*

Sonoma County.

Tehama County. Township twenty-five north, range seven west, with chromic iron in large quantities.

Yuba County.

134. SIDERITE. Spathic iron, carbonate of iron.

This mineral has recently been found by J. W. Redway in quartz ledges in Tejunga Cañon, Los Angeles County, and is represented in the State Museum by No. 3712.

Silicified Wood—See Quartz.

Silicate of Copper—See Chrysocolla.

135. SILVER. While silver minerals are abundant in California, native or free silver is of rare occurrence; it is even then found only in specks or very thin sheets, covering but small surface. This is the case in Mono County in the Diana, Kerrick, and Comanche Silver Mines, where it is sometimes seen on partzite, and in the Tower Mine, near Benton. It occurs, also, in the silver ores in Inyo County, notably in the Kearsarge District, in the form of electrum (gold alloyed with silver or the reverse). It is found, also, in Bodie, in Mono County, and in Fresno County, near Millerton.

Silver Glance—see Argentite.

Slate—see Building Stones.

136. SMITHSONITE. Carbonate of zinc. Said to occur with cerusite in the Modoc Mine, Inyo County.

137. SODA NITER. This important mineral is nitrate of soda. Found only in small quantities in caves and cavities in the rocks near Calico, San Bernardino County. It is reasonable to expect from the nature of the climate that it will be found in greater quantity.

Specular Iron—see Hematite.

138. SPHALERITE. Blende, zinc blende, black jack, sulphuret of zinc.

Zinc blende is very abundant in California, disseminated through the vein matter in gold and silver mines, but has not been found in distinct veins. When concentration becomes more general in treating low grade ores, zinc will be considered worthy of attention, and will be saved and utilized. It occurs at Meadow Lake, Nevada County, in considerable masses, with galena, pyrite, and chalcopyrite; and associated with yellow copper in the Lancha Plana and Napoleon Copper Mines in Calaveras County (Blake).

It is represented in the State Museum by the following specimens: White Chief Mine, Mineral King District, Tulare County; Dennis Martin's ranch, four miles west of Menlo Park, San Mateo County; with calcite, Small Hill Mine, Santa Catalina Island.

Sphene—see Titanite.

Stalacite—see Calcite.

Stalagmite—see Calcite.

Steatite—see Talc.

139. STEPHANITE. Brittle silver ore, brittle sulphuret of silver. Found in the Morning Star Mine, Alpine County (Dana).

140. STIBICONITE. Partzite, antimony ochre, hydrous oxide of antimony. Partzite is found in abundance in Mono County. It seems to be

a mechanical mixture of stibiconite with other oxides, and is always rich in copper and silver.

Magnificent specimens with free silver are found in the Diana, Kerrick, and Comanche Mines, Blind Springs District, Mono County. Specimens may be seen in the State Museum from the Kerrick Mine, Benton, Mono County; from the Comanche Mine, Blind Springs, Mono County; and with native silver and galena, from the Tower Mine, near Benton, Mono County.

141. STIBNITE. Sulphide of antimony, antimony glance.

Stibnite is not a common mineral in California as far as known, but there are several important localities, some of which are likely to be productive. It is found in small quantities, with cinnabar, in most of the quicksilver mines of the State.

Inyo County. Panamint, in large veins.

Kern County. San Emidio Cañon, township ten north, range twenty-one west, sections nine and ten, S. B. M. This is probably the largest deposit of antimony ore in the State. It is likely to be worked to a considerable extent in the near future; preparations are being made with that end in view. Stibnite has also been found near Kernville in the same county.

Lake County. With cinnabar and chalcedony in quicksilver mines.

Mono County. Head of Bloody Cañon.

San Bernardino County. Centennial Mine, in washed bowlders.

San Benito County. At the Alta Antimony Mine, where it occurs in considerable quantity. This mine has been somewhat worked, but at the present time it has been suspended.

Santa Barbara County. (Dana.)

Tulare County. Mineral King District.

142. STROMEYRITE. Silver copper glance.

It occurs with other silver and copper ores in the White Mountains, Inyo County (Aaron), and is not uncommon in the Inyo Mountains, from White Mountains to Coso.

SULPHATE OF COPPER—see Chalcanthite.

SULPHATE OF IRON—see Coquimbite.

SULPHATE OF SODA—see Thenardite.

143. SULPHUR.

While indications of sulphur are very common in the State, there are but few localities where the mineral occurs in any considerable quantity. The following is the most important:

Colusa County. At Sulphur Creek, where it occurs with cinnabar, petroleum, gold, and other minerals.

Inyo County. Near Little Owens Lake, said to be in considerable quantity.

Kern County.

Lake County. Near Clear Lake and Borax Lake. At this locality, known as the sulphur bank, 1,881,697 pounds of commercial sulphur were produced before it was discovered to be the croppings of a quicksilver mine.

Los Angeles County. Quantity unknown.

Napa County.

San Bernardino County.

San Diego County. At the mud volcanoes described in the second annual report of the State Mineralogist.

San Luis Obispo County.

Santa Barbara County. In the Azufre Mountains.

Tehama County.
SULPHURETS AND SULPHURET OF IRON—see Pyrite.
SULPHURETS OF SILVER—see Argentite.

144. SYLVANITE. Telluride of gold. This rare mineral is said to exist in the Melones and Stanislaus Mines, with other tellurium minerals.

145. TALC. Steatite, soapstone, French chalk. This in various forms is a very abundant mineral in this State, as may be seen by the following localities, mostly represented in the State Museum:

Amador County. Two miles northeast of Jackson; *soapstone* in large deposits and of excellent quality.

Calaveras County. Near Murphy's; also at Rocky Hill and Jenny Lind Hill (Trask).

Catalina Island. The *soapstone* of which the California Indians made cooking dishes, came from this island. This is stated by Abel Stearns, a well known pioneer.

Fresno County.

Inyo County. Alabama Range, a greenish, translucent variety (Aaron).

Kern County. Soapstone Mountain.

Los Angeles County. Fourteen miles below San Pedro, on the coast.

Marin County. Taylorville, Paper Mill Creek.

Mariposa County. Coulterville, *soapstone* of excellent quality, and said to be in large quantities. At Lewis (soapstone). In quartz with gold, Yosemite Mine.

Mendocino County. Township nineteen north, range ten west, said to be in quantity.

Nevada County. Grass Valley, wall rock of Maryland Mine.

Placer County. *Foliated talc* near Auburn. *Soapstone*—Stockbridge Soapstone Quarry and Works, township fifteen north, range nine east. The deposit was formerly worked for gold, which it contains in small quantity. This mineral (soapstone) which exists in large deposits, has been used extensively in lining the furnaces in the Alabaster Lime Works, near Auburn, and found very refractory.

Plumas County. Rock Island Hill.

San Diego County. *Foliated talc* with chalcopyrite.

Santa Clara County. Seven miles from Mount Hamilton.

Sonoma County. Pine Flat, *talc resembling French chalk.*

Tulare County. Tule River *soapstone* of excellent quality, suitable for use as a fine resisting material.

Tuolumne County. *Soapstone* in beds eight feet thick(?)

Yuba County.

TCHERMIGNITE—see Alum.
TELLURIC GOLD—see Sylvanite.
TELLURIDE OF SILVER—see Hessite.
TELLURIUM—see Altaite, Calaverite, Hessite, Petzite, and Tetradymite.

146. TETRADYMITE. Bismuth, with tellurium.

Professor Blake discovered a tellurium mineral in the Melones Mine, Calaveras County, which he thought might be tetradymite, associated with gold. According to Willard, it occurs with massive gold in the Morgan Mine, Carson Hill, and in the Melones Mine, Calaveras County. It is said, also, to be found in the Murchie Mine, Nevada County.

147. TETRAHEDRITE. Gray copper, fahlerz, freibergite.

This mineral is a double sulphide of copper and antimony, of which there are numerous varieties. When it contains silver it is named freibergite. The following are the few known localities in the State:

Calaveras County. At Coulterville and at Carson Hill, associated with gold. Freibergite rich in silver has recently been found disseminated through milk-white quartz in the Live Oak Mine. It is sometimes found in considerable masses associated with chalcopyrite and azurite. A specimen examined by me was found to be to the quartz in the proportion of five per cent, and to contain gold and silver as follows:

Gold	7.5 ounces per ton of 2,000 pounds.
Silver	256.1 ounces per ton of 2,000 pounds.

It is therefore a valuable silver ore, and can be easily concentrated. The quantity is not known.

Inyo County. In the White Mountains, on Jacob's Wonder Mine, Panament, and elsewhere in the county.

Mariposa County. With gold in the Pine Tree Mine.

Plumas County. Irby Holt Mine, Indian Valley.

Tuolumne County. Golden Rule Mine.

148. THENARDITE. Anhydrous sulphate of soda.

Thenardite is found in large quantities with hanksite, tincal, trona, gaylussite, and other minerals, at the works of the San Bernardino Borax Company. For further particulars, see third annual report of the State Mineralogist, 1883.

THINOLITE—see Calcite.

TIN ORES—see Cassiterite.

TINCAL—see Borax.

149. TITANITE. Sphene, titaniferous iron.

Titaniferous iron is found in iron sand in Spanish Creek, Plumas County (Edman). Sphene is in small hair-form crystals in the granite of the Sierra Nevada (Blake), and in albite, Fine Gold Gulch, Fresno County.

150. TOURMALINE. Rubellite, schorl.

Is a mineral almost invariably found crystallized, of all colors, from opaque black to nearly or quite transparent colorless. The usual colors are: *black* (schorl), *red* (rubellite), *blue* (indicolite), *green* (crysolite), *honey-yellow* (peridot), *colorless* (achroite).

All the tourmalines contain boracic acid, from three to ten per cent. This mineral has never been worked for boracic acid, but is probably a source of that acid in nature, resulting from the decomposition of rocks containing it.

The localities of tourmaline are not many in the State. The following are known:

Calaveras County. In white quartz, schorl.

Contra Costa County. Near Bay of San Francisco.

Fresno County. Fine Gold Gulch: schorl, with quartz and feldspar.

San Bernardino County.

RUBELLITE (rose colored tourmaline). This very interesting mineral is now observed for the first time in California in the form of long slender crystals from one sixteenth to one eighth of an inch in transverse diameter, with the usual triangular section. Color, a beautiful rose pink, contrasting

well with the matrix of white lepidolite. When ignited, the color disappears and the mineral becomes perfectly white; infusible (Blake).

San Diego County. Schorl, on the north side of San Felipe Valley in feldspathic veins. For description see Report Geological Reconnaissance of California (Blake, folio 304).

Tulare County. *Schorl* in granite on the summit of the Sierra Nevada.

Tuolumne County. Large crystals of *schorl* are found in granite on the summit of the Sierra.

TRAVERTINE—see Calcite.

TREMOLITE—see Amphibole.

151. TRONA. Sesquicarbonate of soda. This mineral is found with salt, thenardite, tincal, hanksite, and gay-lussite, at the works of the San Bernardino Borax Company, and is utilized to some extent in the manufacture of borax. It is also found in Death Valley, Inyo County, and at other localities in the Mojave and Colorado Deserts.

TUFA—see Calcite and Aragonite.

152. TURBITH MINERAL. Yellow sulphate of mercury. Is not found in nature. Specimens taken from the interior of the furnaces at the Sulphur Bank Quicksilver Mine, Lake County, were exhibited by T. Parrott at the Paris Exposition of 1878, and at his request were delivered to the School of Mines, Paris, at the close of the Exposition.

153. ULEXITE. Borate of lime, tiza, boronatrocalcite, natroborocalcite, tinkalzit, cotton balls, sheet cotton, etc. Ulexite is a hydrated borate of lime and soda. The history of the discovery of ulexite in Nevada is given in detail in the third annual report. The following localities are represented in the State Museum: The variety technically known as "sheet cotton," containing free boracic acid, from Death Valley, Inyo County, and borax made from it by decomposing with carbonate of soda; "sheet cotton," from Desert Springs Lake, Kern County, with boracic acid made from it by the Boracic Acid Manufacturing Company of San Francisco.

VARIEGATED COPPER ORE—see Bornite.

154. VESUVIANITE. Idocrase. Is a silicate of alumina, lime, iron, etc., first found in the ancient lavas of Vesuvius, whence the name. It has been found in the Siegel Lode, El Dorado County (Blake). Some years ago, Mr. S. S. Taylor sent a fine specimen to San Francisco from Spanish Ranch.

VITREOUS COPPER—see Chalcosite.

VITREOUS SILVER—see Argentite.

155. VIVIANITE. Among a set of samples from Brea Ranch, Los Angeles County, sent to the State Mining Bureau by Mr. J. W. Redway, of Los Angeles, was one of dark color and earthy texture, containing small nodular masses of a beautiful pale blue color, which were examined and found to be vivianite, or hydrous phosphate of iron. This mineral, which is rare in California, is interesting as leading to the hope that other phosphates, so important as fertilizers, may be found at or near the new locality. There is a specimen of vivianite in the Museum of the State University, which is said to be from a California locality, but, if my memory serves me, this is attended with some doubt. It is reported also at Young's Hill, Yuba County, and near Oroville, Butte County, but no certain information has been obtained. The Los Angeles mineral occurs with asphaltum, at

the well known Brea Ranch deposit. The specimen is marked "Gangue and Country Rock." The mass is a dark colored earthy mineral, with streaks and veins of asphaltic substance, the whole being evidently the sandy desert soil blown over liquid asphaltum and cemented by it. The vivianite is in small inclosed nodules, never larger than a pea, and generally smaller. The mineral is that variety known as blue iron earth or native Prussian blue. It is soft, pulverulent; under the microscope, crypto-crystalline; before the blowpipe, whitens for an instant, then blackens and fuses to a black magnetic globule. It is wholly and easily decomposed, by boiling hydrochloric acid; the solution reacts for iron. which, being separated, the solution gives precipitates with sulphate of magnesia and with molybdate of ammonia. In a closed tube it gives much water. The specimen has been numbered 3538, and placed in the State Museum.

Wood Opal—see Opal and Quartz.

Wood Tin—see Cassiterite.

156. WOLFRAMITE. A mineral numbered 3731 in the museum, was entered as *ilmenite*, which it was supposed to be. Quite lately a specimen was sent to Washington and was there named *samarskite*. Doubt being thus thrown on the mineral, I was induced to make a careful examination of it, and found it to be as above. The reactions obtained were as follows: Color, brown to black; luster, metallic; streak, brown red. Hardness, 4.5. Specific gravity, 7.14. Fuses with difficulty to a bead which is slightly magnetic. In closed tube shows traces of water; partly decomposed by boiling nitro-hydrochloric acid, yields a yellow solution and a voluminous yellow residue; decomposed by fusion with bisulphate of potash, hydrochlorine acid added, gives yellow solution and residue of tungstic acid. From this solution ammonia throws down a heavy precipitate of iron.

Scheelite and cuproscheelite are known in the State, but there is the first instance of the occurrence of wolframite that has come to my notice; the locality is Mariposa County, twenty miles south of Mariposa, near Buchanan.

157. WULFENITE. Molybdate of lead. This mineral is found as yet but sparingly in California, although it is abundant in Nevada and Arizona. It is represented in the State Museum by No. 5351, as small, perfect, tabular crystals, in ore from a mineral vein containing other lead minerals, six miles northeast of Cave Springs, Kern County. In Owens River Valley, Inyo County, the miners are often vexed by finding a heavy yellow mineral in the pan or horn spoon, mixed with the gold prospect, which so much resembles the noble metal that they are frequently deceived by it. It is probably molybdate of lead, the specific gravity of which is from 6 to 7.

Yellow Copper Ore—see Chalcopyrite.

Yellow Ochre—see Limonite.

158. ZARATITE. Emerald nickel, hydrate of nickel, hydrated carbonate of nickel. A rare mineral and one that is never found in large quantities; generally as a thin coating on serpentine and chromic iron. It was observed by Blake on chromic iron in Monterey County. Dr. Trask reported it also with chromic iron at Panoches, Gabilan Mountains, Cañada of San Benito, and in Alameda County. It has lately been found in Mendocino County, in township twenty north, and range fourteen west, on chrome iron. It is said to occur on bowlders of chromic iron.

159. ZEOLITE. The name zeolite applies to a group of minerals which includes at least twenty species; the name is, therefore, indefinite. They are all hydrous silicates of alumina, and generally are found in lavas and amygdaloids. There are several minerals in the State Museum from California which have been provisionally referred to the zeolites, pending future analysis and determination. In lava, North Fork Mining District, Fresno County. In lava, Eureka, Humboldt County. In cellular lava, Soledad Cañon, Los Angeles County.

Zinc Ores—see Blende, Sphalerite, and Smithsonite.

160. ZIRCON. Jargon, silicate of zirconia. Zircon has not as yet been found in place in California, but is abundant in beautiful but small crystals in alluvial sands. In cleaning up hydraulic mines it might be collected by the ton if it had any value, but zirconia is not much used in the arts. The sands and final concentrations from the hydraulic mines are very interesting, consisting as they do of gold, platinum, quartz, barite, magnetite, cinnabar, as well as zircons, and sometimes diamonds. Zircon sands are more abundant in some localities than in others; the following localities are the most important:

Arroyo Seco and Irish Hill, *Amador County;* Spring Valley Hydraulic Mine, Cherokee, *Butte County;* in splendid crystals, Picayune Flat, *Fresno County;* in the sands of the Novarro River, Anderson Valley, *Mendocino County;* and Eagle Gulch and Rock Island Hill, *Plumas County.*

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CALIFORNIA STATE MINING BUREAU.

WILLIAM IRELAN, JR., STATE MINERALOGIST.

SIXTH ANNUAL REPORT

OF THE

STATE MINERALOGIST.

PART II.

FOR THE YEAR ENDING JUNE 1, 1886.

SACRAMENTO:
STATE OFFICE.......JAMES J. AYERS, SUPT. STATE PRINTING.
1887.

To his Excellency George Stoneman, *Governor of the State of California:*

Sir: The Trustees of the State Mining Bureau herewith submit their report, in pursuance of the Act of the Legislature entitled "An Act supplementary to an Act entitled 'An Act to provide for the establishment and maintenance of a Mining Bureau,' approved April 16, 1880."

Respectfully,

J. Z. DAVIS,
S. HEYDENFELDT, Jr.,
W. S. KEYES,
GEORGE HEARST,
Trustees.

San Francisco, October 1, 1886.

REPORT OF THE TRUSTEES OF THE STATE MINING BUREAU.

In pursuance of the Act of the Legislature entitled "An Act supplementary to an Act entitled 'An Act to provide for the establishment and maintenance of a Mining Bureau, approved April 16, 1880,' approved March 21, 1885," his Excellency George Stoneman, Governor, appointed J. Z. Davis, Esq., S. Heydenfeldt, Jr., Esq., William Irelan, Jr., Esq., Walter E. Dean, and Hon. George Hearst, Trustees. On the thirteenth day of April, A. D. 1885, a majority of the Trustees organized as a Board, and adopted rules and regulations.

On the thirtieth day of May, A. D. 1886, Henry G. Hanks, Esq., the State Mineralogist, resigned his office, and William Irelan, Jr., Esq., was appointed in his place, and W. S. Keyes, Esq., was appointed as one of the Trustees, in place of William Irelan, Jr., Esq.

REMOVAL.

In consequence of a notice given by Alvinza Hayward, Esq., the owner of the premises, No. 212 Sutter Street, that he intended to rebuild, it became necessary to find other premises for the "Bureau," and the Trustees leased the south half of the third floor and the whole of the fourth floor of the premises known as the New Pioneer Building, on Fourth Street, south of Market, No. 24.

The large collection in the Museum of the Bureau was moved during the month of December, with scarcely any damage. The fourth floor of the premises is used for the Museum, and the south half of the third floor is divided into four rooms: one devoted to the Library, two for storage of duplicates, packing, etc., and one for the office of the State Mineralogist.

MUSEUM.

There are one hundred and twenty flat cases, sixty of which were added by the Trustees, and ten large, upright cases built in the Museum, all of which are full. Seven thousand specimens were entered, classified, and catalogued, by Henry G. Hanks, Esq., former State Mineralogist, and two thousand by the present State Mineralogist, making a total of nine thousand.

Many articles, which are not geological or mineralogical specimens, and which are not kindred to the subjects of Geology, Mineralogy, or Paleontology, have been donated to the Bureau, and as many of them are valuable, interesting, and attractive, the Trustees have deemed it advisable to accept such contributions, and give them a place in the Museum.

A complete rearrangement of the ores and economic minerals of the State, has been made, under the direction of the present State Mineralogist, and such ores and minerals are grouped according to their respective characters, as well as by counties.

FACILITIES FOR RECEIVING SPECIMENS.

Wells, Fargo & Co.'s Express, from the first creation of the Mining Bureau, have transported packages (weighing less than twenty pounds) from all parts of the State, and from the neighboring States and Territories, free of charge, and continue to do so.

The Trustees recognize and appreciate the value and importance of this generous assistance rendered to the Bureau.

VISITORS.

The visitors to the Museum of the Bureau, from March 3, 1885, to November 1, 1886, number four thousand four hundred and seventy-five, as appears by the register, which, however, does not represent the total number, as about fifty per cent of persons visiting the Bureau fail to register.

List of Donors to the Museum of the Bureau Since the Issue of the Fourth Report.

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Young, R. A.

LIBRARY.

A catalogue of the books and pamphlets in the library has lately been prepared, but has not yet been sent to the State Printer for publication.

Many valuable books of reference have been sent to the Bureau by our Senators and Representatives in Congress, and by Hon. J. P. Jones of Nevada.

The various departments of the Federal Government, and particularly the "United States Geological Survey," continue to send valuable books to the library of the Bureau.

A complete set of the reports of the Second Geological Survey of Pennsylvania has been kindly given to the Bureau by the Governor of Pennsylvania, and the following State Geological Survey Reports are also in the library:

Illinois, vols. 1 to 7 (vol. 5 missing).

Indiana, 1869–70–72–73–74–75–78, and 1883; also, 1 vol. of maps.

Iowa, vols. 1 and 2.

Minnesota, 1 vol. from 1872 to 1882; also the First to Twelfth Annual Reports, excepting the Second, Third, and Sixth.

Missouri, Annual Reports 1 and 2, and 1 vol. of the Survey.

New Jersey, 1868–69, and 1874; 1881–82–83–84, and 1885.

Ohio, vol. 1, two parts, and vol. 2, two parts, and 1 vol. of 1869.

The Trustees hope to procure complete sets of the reports of all the States which have made Geological Surveys.

The books in the Library number *one thousand one hundred and twenty-three.* This, however, does not include sixty pamphlet boxes of valuable unbound pamphlets.

NEWSPAPERS.

The following newspapers continue to be sent to the State Mining Bureau free:

1. Arizona *Gazette*, Phœnix, Arizona Territory.
2. California *Demokrat*.
3. Daily Grass Valley *Union*, Nevada County, Cal.
4. *Engineering and Mining Journal*, New York.
5. *Golden West*, San Francisco, Cal.
6. Humboldt *Standard*, Eureka, Humboldt County, Cal.
7. Inyo *Independent*, Inyo County, Cal.
8. *Mining Record*, New York.
9. *Mining Review*, Chicago, Ill.
10. Sierra County *Tribune*, California.
11. Ventura *Free Press*; San Buenaventura, Cal.

ACCOUNTS OUTSTANDING AGAINST THE STATE MINING BUREAU.

The following indebtedness was created by Henry G. Hanks, Esq., while State Mineralogist, prior to the thirty-seventh fiscal year, and remains unpaid. The Trustees recommend the payment of the same:

Advances made by Wells, Fargo & Co.	$3,968 00
Several small accounts for material and supplies furnished to the Bureau, amounting to	218 10

Accounts from April 1, 1885, to October 1, 1886.

Museum, library, and general expense	$4,423 76
Salary of State Mineralogist	4,500 00
Traveling expenses	989 55
Rent at 212 Sutter Street, from April 1, 1885, to December 1, 1885	1,600 00
Rent at New Pioneer Building from January 1, 1886, to October 1, 1886	2,025 00
Expense of moving	302 00
Salary of employés	2,617 00
Total for 18 months	$16,457 31

RECEIPTS.

Balance of appropriation for thirty-sixth fiscal year	$438 64
Paid into State Mining Bureau Fund, April 16, 1885	497 35
Paid into State Mining Bureau Fund, June 30, 1885	222 66
Appropriation for thirty-seventh fiscal year, July 1, 1885	10,000 00
Paid into State Mining Bureau Fund, July 13, 1885	1,284 04
Paid into State Mining Bureau Fund, October 13, 1885	753 30
Paid into State Mining Bureau Fund, January 12, 1886	1,150 05
Paid into State Mining Bureau Fund, April 13, 1886	346 30
Appropriation for thirty-eighth fiscal year, July 1, 1886	10,000 00
Paid into State Mining Bureau Fund, July 13, 1886	972 10
Total	$25,664 44

Appropriation and Mining Bureau Fund.

Total	$25,664 44

DISBURSEMENTS.

Total	16,457 31
Balance of appropriation, and in Mining Bureau Fund	$9,207 13

NEEDS OF THE BUREAU.

The appropriations made for the support and maintenance of the Bureau have always been inadequate to carry out the objects contemplated by the Act by which it was created.

The collection of ores and minerals in the Bureau is of incalculable benefit. Persons seeking to study and compare them are afforded every facility.

A record of the locality of each mineral is kept, and any one who is about to engage in any mining industry can get information of great value.

The Bureau seeks to give as much publicity as possible to all discoveries of gold and silver, as well as mineral substances, which may be useful in the arts and manufactures.

Notwithstanding the advantages which have already accrued to the State by creating the Bureau, the Trustees feel that it can be made more useful to the public, and its importance more generally felt, if sufficient means be placed at their disposal.

The material accumulating will require a gallery to be built on the fourth floor, to properly exhibit the minerals.

A Chemical Laboratory is needed, and can be built on the west side of the third floor.

Many books on Geology, Mineralogy, and Metallurgy are also needed, and should be purchased for the library, as constant application is made for them.

Adolph Sutro, Esq., some time ago, presented to the Bureau a complete set of the rocks of the Sutro Tunnel, seven hundred and eighty in number, from the main tunnel, north and south laterals, and the four shafts; and Mr. Charles Forman donated a set of the rocks of the Forman shaft of the Overman mine, in number four hundred and sixty-eight, taken from every *five* feet from surface to the two thousand three hundred and forty foot level. These are in the Bureau, and have never been determined or classified.

There are also four or five cases of lithological specimens from California, also the wall rocks of many of our gold mines. All these specimens require determination, and in order to properly classify them, microscope slides of each are needed, and the Bureau should be in a position to have this important work done under the auspices of a competent lithologist. Too much attention cannot be paid to the proper classification of the inclosing rocks of our gold quartz mines. Its importance is now universally recognized.

The average miner has generally three names for rocks—granite, slate, and porphyry—and the latter name he gives to every rock which is not slate or granite. The study of rocks congenial to the gold-bearing veins is, and has been, too long neglected.

Every effort is being made by the State Mineralogist to secure specimens of the inclosing rocks of the various mines on the coast.

In this connection it may be said that much credit is due to Melville Attwood, Esq., of this city, who is one of the oldest miners on this coast, and a thorough lithologist. He has made a special study of rocks under the microscope, and has written several valuable papers on the subject, and has frequently presented to the Bureau typical specimens of various rocks, with slides prepared for the microscope, and has also assisted in the determination of a number of wall rocks of our California gold mines.

A record of the condition of every mine, about to be closed, should be kept in the Bureau for future reference.

Sufficient assistance should be afforded to the State Mineralogist to conduct experiments much needed. The proper weight of stamps is an open question among the mining men of this coast. By reference to the report of the State Mineralogist it will be seen, that the weight varies from six hundred to one thousand pounds. While it is true that some ores are much harder than others, and some more easily comminuted, yet in some mining districts, where the ore in the various mines is alike in all its characteristics, great differences will be found in the weight of the stamps.

Properly conducted experiments carried on under the direction of the Trustees or State Mineralogist, in various mining districts, would be the proper method of ascertaining a mean weight of stamp, on a given ore.

The condition of gold after it leaves the battery without contact with quicksilver, and its condition after its separation from the quartz by rollers, should be made the subject of most careful study and microscopic examination, with a view of ascertaining its adaptability to rapid amalgamation, as well as to determine whether or no the pulp should be immediately subjected to concentration without amalgamation, in the batteries or on the outside plates, taking into consideration the percentage, composition, and character of the sulphurets.

The questions of weight and drop of stamps, use of quicksilver, size of screens, discharge of pulp, inclination of plates, condition of the sulphurets, concentration, chlorination, etc., should be investigated by actual experiment in different mining districts on the various characters of our gold-bearing quartz.

The Bureau has a large number of maps of California and of different sections of the State acquired for the purpose of facilitating the making of a good and reliable geological and mining map of the State. The Trustees recommend that such a map be commenced at once, and that every mineral deposit and mine be designated as accurately as possible.

The object which the Trustees mainly have in view, is to encourage the development of the great mineral resources of California.

The existence of the various mineral products which can be utilized in the arts and manufactures, and afford the bases of important industries in the State, have not been made known as widely as desired.

The vast importance of the gold production is beginning to be felt all over the world. No country is capable of producing *more* gold, with the same facility and rapidity, than California.

The great auriferous belt of the State, extending as it does from nearly its extreme northern boundary to its most southern counties, is acknowledged to be without parallel in the world. In the museum of the Bureau, are specimens of gold from thirty counties in the State, and this does not include all in which gold occurs.

The low grade ores, and those which are so abundant, carrying principally auriferous sulphurets, from which the gold is successfully extracted at a small cost and in an easy manner, are those which are now receiving the attention of practical miners.

This industry, contributing so materially to the welfare of the people, should receive the fostering care of the State.

The *Engineering and Mining Journal*, of January 23, 1886, published in New York by Richard P. Rothwell, M.E., and Dr. Rossiter W. Raymond, in reviewing the Fifth Annual Report of the State Mineralogist, commenting on the meagerness of the appropriations made to the support of the Bureau, says:

The once liberal expenditures of the State of California, for the thorough study and description of its mineral resources, have dwindled to an annual pittance, which is a subject for combined regret and ridicule. Whatever may have been the reason for this change, it is a pity that the reaction has gone so far to the other extreme.

It is to be deplored that our Legislatures have, for a successive number of years, seemingly ignored the importance of our mineral deposits.

Our Geological Survey failed for want of appropriations in 1873–4, and has been discontinued ever since; the Mining Bureau was not established until 1880, and has never received the financial assistance needed.

The smallest of the Colonies of Great Britain give more attention and encouragement to their mining interests than the State of California.

The *Mining and Scientific Press*, October 30, 1886, in an editorial on the "Subsidies to Mining in New Zealand," compiled from the "Mines Statement," by the Minister of Mines of New Zealand, made July 6, 1886, says:

What to us in this country seems rather a curious feature is the fact that the Government aids the miners in building roads, prospecting, etc. The cost of roads and tracks undertaken by counties in the gold fields last year amounted to £54,137 ($262,464 45), out of which subsidies paid were £35,630 ($172,805 50), and the cost of similar works undertaken and wholly paid for by the Department of Mines was £16,275 ($78,933 75). So far as the Mines Department is responsible, the total cost of such works constructed and in progress will be, when complete, £150,164 ($728,295 40). Several roads are being built to open up new mines. From time to time Government aid has been given to prospecting, with the object of developing the mineral wealth of the colony. This assistance has been extended to prospecting associations, companies working at deep levels, and laterly, under regulations made by the Governor-in-Council, based on recommendation to the Minister of Mines by the Gold-fields Committee, to the local bodies, and, under special circumstances, to individual parties engaged in prospecting in outlying districts.

Subsidies in aid of the purchase of diamond drills have been given. The Minister of Mines, however, does not believe in this, and has sent to America to try and find a light and portable machine which can bore five hundred feet.

In the last four years the total amount authorized by the Government for the construction of water-races, drainage and tailings channels, roads and tracks, diamond and other drills, and to aid prospecting in the gold fields, has been £244,447 ($1,185,567 95), and otherwise paid by way of subsidies the sum of £131,044 ($635,563 40). Last year the sum authorized for similar works was £76,804 ($372,499 40). They recognize that roads and trails are very important to open up new districts, and spend a great deal of money in this direction to encourage miners to go to new regions.

In view of these facts, the Trustees of the State Mining Bureau earnestly appeal to the Legislature, to give the aid so greatly needed, which will contribute materially to the wealth and progress of the State, and to the prosperity of her people.

The sum of *one hundred and twenty-five thousand dollars* ($125,000) for the two coming fiscal years, is respectfully suggested, as a moderate appropriation for the support and maintenance of the Mining Bureau.

Respectfully submitted.

J. Z. DAVIS,
S. HEYDENFELDT, Jr.,
W. S. KEYES,
GEORGE HEARST,
Trustees.

Note.—Walter E. Dean, Trustee, was absent from the State of California when this report was made.

SAN FRANCISCO, November 17, 1886.

To Honorable GEORGE STONEMAN, *Governor of the State of California:*

SIR: In accordance with the Act of the Legislature entitled "An Act to provide for the establishment and maintenance of a Mining Bureau," approved April 16, 1880, I herewith transmit my report.

Very respectfully,

WM. IRELAN, JR.,
State Mineralogist.

October 1, 1886.

REPORT OF STATE MINERALOGIST.

On the first day of June, 1886, the present State Mineralogist was commissioned by his Excellency George Stoneman, Governor of the State of California, *vice* Henry G. Hanks, Esq., resigned.

Upon assuming the duties pertaining to the office, as prescribed by the Act of the Legislature entitled "An Act to provide for the establishment and maintenance of a Mining Bureau," approved April 16, 1880, the State Mineralogist, upon conferring with the Trustees of the State Mining Bureau, deemed it advisable to obtain such information concerning some of the leading quartz mines carrying on operations on the great auriferous belt of the State, giving such information as would be of interest to the people of the State, and particularly to those persons who are engaged in gold-quartz mining.

The time, during which the State Mineralogist was expected to give his attention to this subject, was so limited that it became impossible to gather much information or many statistics relating to this great industry of the State.

A few of the leading mines, in several of the counties, were visited in person by the State Mineralogist, and he was enabled to collect some data and gather other information from persons familiar with sections of the State which the State Mineralogist was not enabled to visit, who cheerfully gave descriptions of mining operations which were being carried on.

A number of the leading gold mines were necessarily omitted, as well as most of the mines and prospects, which are said to have a promising future. He hopes that in some future annual report he will be enabled to give a full and complete description of the condition of gold and silver mining throughout the entire State, and not be compelled to neglect a description of the localities of other valuable mineral products which exist so abundantly in California, and to report what developments are being made.

It was suggested by the Board of Trustees, that considering the shortness of time in which he would be justified in leaving the Bureau to make his observations, it would be better to chiefly confine his report to a short description of the developments made and the depths of some of the mines, and give such statistics as he could collate, showing the method of extracting the gold and description of the machinery in use.

The grade of the ore being worked in any of the mines visited by the State Mineralogist is not given, for the reason that the mine owners, in common with persons engaged in commercial business or other economic enterprises, do not wish their private affairs given to the public, and do not care to invite any inspection or publication of their books.

The State Mineralogist desires to acknowledge his appreciation of the uniform courtesy and assistance which has been rendered him by the Trustees. The Bureau is greatly indebted to J. Z. Davis, Esq., the Chairman of the Board of Trustees, who daily gives a portion of his time to its progress. Mr. Davis has the success of the Bureau at heart, and has presented many valuable ores and minerals, besides several cases of interesting conchological specimens, and many other attractive exhibits.

THE MOTHER LODE.

This very remarkable auriferous belt runs in a northwesterly and southeasterly direction, and can be traced for about one hundred miles, from the Mariposa estate, in Mariposa County, through the counties of Tuolumne, Calaveras, Amador, and into the county of El Dorado. The lode dips to the eastward at an angle of from 45° to 70° to the horizon. The walls are uniform and the gouge well defined; the vein matter is white and banded quartz, carrying a small percentage of sulphurets. The eastern, or hanging-wall, is greenstone, and the western, or foot-wall, is slate.

Professor Whitney remarks of this lode:

> It is not by any means a continuous bed or vein of quartz, but rather a series of nearly parallel belts of lenticular masses with barren intervals between them, but yet arranged nearly in the same course.

R. H. Stretch says:

> The mother lode is not, strictly speaking, a continuous vein, but rather a belt of gold-bearing rocks, situated in a line of contact between black clay slates on the west and greenstone on the east. On each side of the contact, for a limited distance, the rocks are more or less mineralized with gold, and hence we have, in many cases, a series of more or less parallel locations indicating the points at which the quartz segregations have shown themselves on the surface. When the line of contact is more nearly vertical, the quartz bodies seem to be more solidly compacted and continuous; when it is flatter they seem to be more disseminated through the lateral country rock. Usually there is quartz on the line of contact, and one or more bodies between the hanging and foot-walls.

AMADOR COUNTY.

This county is about fifty-five miles long, with an average width of twelve miles, and although it has less area than most of the other mining counties of the State, it ranks, at present, among the foremost in production of gold. It is bounded on the north by El Dorado County, and by Calaveras on the south, and through its central portion, in a northwesterly and a southeasterly direction, runs the mother lode. East of the mother lode there is a belt of limestone, entering from Calaveras County, passing Volcano and extending toward the Sierras. The formation in the southern part of the county is of a volcanic origin, whilst in the northern portion are the gold-bearing slates.

Throughout the whole extent of the auriferous belts of the county there is an unusual amount of activity, and a decided feeling of contentment, not only in the present satisfactory production of the mines, but in expectation of an enlarged future yield. Properties abandoned in the years gone by, on account of the high price of labor, and the expense of motive power consuming the production, have recently been reopened, and, by the substitution of water for steam, are now in paying condition; again the developments in the new finds are very encouraging.

PLYMOUTH CONSOLIDATED.

As a dividend-paying property, this mine is not excelled by any other on the mother lode. The mine in altitude is 1,050 feet above sea level, has a length of 4,800 feet on the lode; both hanging and foot-walls are slate; the course of the vein is north and south, dips 55° to the east, and has an average width of 30 feet. There are two water power mills on the property of 80 and 40 stamps respectively. In the larger mill the stamps weigh

750 pounds each, whilst in the smaller, the weight of each stamp is 1,000 pounds; the fall of the stamps is 7 inches, at the rate of from 90 to 100 times per minute, crushing about two tons to the stamp every 24 hours. The method of recovering the free gold is by amalgamation in the batteries and collection on the outside plates; the sulphurets are collected on Frue concentrators, and worked by the chlorination process, at the company's works, at an expense of $10 per ton.

The following is the last quarterly report of the company:

.The dividend paid on October fifth by the company, was the forty-first consecutive monthly dividend, making a total of $1,775,000. It is stated that the mine has more ore developed than at any previous period in its history. At present the mills are supplied with low grade rock from the upper levels. No stoping has been done in the bottom, the ore there being reserved for future use. The entire plant, including mills, shops, etc., is in perfect running order. Level No. 6 (1,500 feet) has been opened one quarter of its length, and promises to be the best in the mine. Large masses of low grade rock have been uncovered between the 800 and 900 levels, and a new ore body is now being worked on the 800. Its full size is unknown, but appearances indicate an extensive deposit.

GOLD BULLION PRODUCED.

January, 1886	$55,683 47
February	45,611 11
March	53,897 81
April	50,778 91
May	49,502 13
June	44,166 43
July	44,566 75
August	51,528 16
September	51,812 36
Total product for nine months, 1886	$447,547 13
Operating expenses for same period	193,145 00
Profit	$254,402 13
Cash on hand, January 1, 1886	43,081 45
Amount applicable to dividends	$297,483 58
Paid dividends for quarter, Nos. 32 to 40, $25,000 each	225,000 00
Cash surplus, October 1, 1886	$72,483 58

Altitude, feet	1,050
Number of stamps	120
Weight of stamp, pounds	750–1,000
Drop of stamps, in inches	7
Drop of stamps, per minute	90–100
Duty of stamp in twenty-four hours, tons crushed	2
Depth of shaft, vertical, feet	1,500
Length of ore-shoot, feet	800
Average width of vein, feet	30
Percentage of sulphurets	1½
Value of sulphurets, per ton	$135
Number of concentrators	32

KEYSTONE CONSOLIDATED

Is situated at the southeast end of the town of Amador, about two miles northwesterly from Sutter Creek, in the Amador Mining District, and has an altitude of 1,000 feet above sea level. The consolidation includes Spring Hill, Geneva, and Garfield claims. The location was made in 1850, and has since been worked almost continuously. The eastern, or hanging wall, is a metamorphic rock called by the miners greenstone, but so far the foot or western wall is not well defined. Lying against and on the west side of the greenstone is a large vein of low grade quartz; thence westerly there are from 200 to 300 feet of argillaceous slate in which the best ore deposits

occur, thence an admixture of slate and spar in which ore does not exist. The average width of the zone is about 400 feet; the course of the vein is northwesterly and southeasterly. The hanging-wall dips easterly at an angle from 45° to 60° at the surface, and 45° at the bottom; length of the shoot is 800 feet. There are two shafts north and south; the north shaft, used for hoisting the ore from the mine, is 1,305 feet on the incline of 49°, reaching a vertical depth of 1,000 feet; the south shaft, used exclusively for pumping out the water, is 1,125 feet on an incline of from 42° to 55°, with a vertical depth of 780 feet. The nature of the ores is free milling, carrying from one and one half to one and three quarters per cent of auriferous sulphurets. The method of reduction is crushing by stamps, and of recovery is amalgamating in the battery and collecting on copper plates on the outside. On the east side of the contact is a large, poor vein of quartz, varying in thickness from 2 feet to 40 feet, which is very spotted; 200 feet west from the greenstone, in the argillaceous slates, occur the next deposits, which are irregular and confined to a northwest and southeast channel; these deposits are from 2 feet to 30 feet thick, and a better quality of ore than that which is found on the east side. The west channel is from 300 feet to 500 feet west of the greenstone, from 3 feet to 40 feet in ore of the best quality found in the mine, paying as high as $40 per ton.

The sulphurets are iron pyrites combined with a small percentage of arsenical and antimonial sulphurets, and have an assay value of $110 per ton. The method of saving the sulphurets is by Hendy concentrators, riffles, and blanket sluices, and the gold is extracted therefrom at a cost of $20 per ton to the company at the chlorination and leaching works of Barney & Voorhies, Sutter Creek.

The mill is run by water-power; contains 40 stamps of 750 pounds each, with a drop of from 7 to 8½ inches, 96 times per minute, crushing 2½ tons to the stamp in 24 hours. The batteries are both high and low discharge, with number 8 slot screens; the apron plates are 16x14 inches, and sluice plates 14 inches wide. The total length of the plates for the 40 stamps is 80 feet, with an inclination of 3½ inches in 10 feet. The amount of water used in 24 hours, in mill, is 125 inches, with a pressure of 254 feet.

Altitude of mine above sea-level, feet	1,000
Number of stamps	40
Weight of stamp, pounds	750
Drop of stamps, in inches	7–8½
Drop of stamps, per minute	96
Duty of stamp in 24 hours, tons crushed	2½
Size of screens, slot	8
Miner's inches of water used in mill in 24 hours	125
Pressure of water, feet	254
Cost of mining, per ton	$3 50
Cost of milling, per ton	75
Percentage of recovery saved in batteries	85.
Percentage of recovery saved on plates	6–7
Number of concentrators	28
Percentage of sulphurets	1½–1¾
Value of sulphurets, per ton	$110 00
Cost, per ton, of working sulphurets	$20 00
Number of men in mine	90
Number of men in mill	9
Total number of men employed in and about mine	110
Length of ore-shoot, feet	800
Length of ore-shaft on incline, feet	1,305
Vertical depth reached by ore-shaft, feet	1,000
Length of water-shaft on incline, feet	1,124
Vertical depth reached by water-shaft, feet	780

SOUTH SPRING HILL.

This property is two miles northwest of the town of Sutter Creek, and one and one half miles southeast of Amador, in the Amador Mining District, and has an altitude of 1,100 feet above sea level. It is a State of Maine incorporation, but owned principally in Massachusetts. The eastern or hanging-wall is of the same formation, metamorphic, as seen in the Keystone; the foot-wall being slate with a gouge. The dimension of the claim is 600 feet in width, by 1,800 feet in length, with a course running northerly and southerly; an easterly dip, and an average width of vein matter of 22 feet, although in places it reaches 50 feet. The mine is worked through an incline shaft, 800 feet on the incline of about 80°, reaching a vertical depth of 758 feet. The ore is free milling, with the exception of the gold contained in the sulphurets. The method of reduction is crushing by stamps, and of recovery, by amalgamation in the battery and collecting on outside plates; the sulphurets, with an assay value of $125 per ton, in gold, principally iron pyrites, are saved from the sluice tailings by the Frue, Triumph, and Hendy concentrators, and the gold extracted therefrom by chloridizing and leaching at the reduction works of Barney & Voorhies, Sutter Creek, at a cost to the company of $20 per ton.

The mill is run by water power and contains, at present, 20 stamps, although 10 additional stamps have been contracted for, to be put in place at once. The stamps weigh 750 pounds each, have a drop of from 6 to 7 inches, 90 times per minute, and crush 2½ tons in 24 hours. The batteries are low discharge with number 7 slot screens; the aprons and sluice plates are silver plated, the former being 24 feet by 48 inches, and the latter being 15 inches wide by a total length of 128 feet. The amount of water, per 24 hours, used in the mill is 70 inches, with a pressure of 325 feet. Developments and improvements during the year, from January first to August first, consist of upraise from 500 foot level to the surface, a drift of 200 feet on 700-foot level and several back drifts, new retort house; expended $2,000 on hoisting works, and under course of erection an addition of 10 stamps.

Altitude of mine above sea level, feet	1,100
Number of stamps	20
Weight of stamp, pounds	750
Drop of stamps, in inches	6–7
Drop of stamps, per minute	90
Duty of stamp in 24 hours, tons crushed	2½
Size of screens, slot	7
Miner's inches of water used in 24 hours in mill	70
Pressure of water, in feet	325
Cost of mining, per ton	$2 50
Cost of milling, per ton	65
Percentage of recovery saved in battery	60
Percentage of recovery saved on plates	30
Number of concentrators: 2 Frue, 2 Triumph, 5 Hendy; total	9
Percentage of sulphurets	1
Value of sulphurets, per ton	$125 00
Cost of working sulphurets, per ton	$20 00
Number of men in mine	40
Number of men in mill	6
Total number of men employed in and about mine	60
Length of ore-shoot, feet	475
Average width of vein, feet	22
Length of shaft, on incline, feet	800
Vertical depth reached by shaft, feet	758

The dividends of the mine are about $30,000 per month.

THE STEWART MINE,

At Sutter Creek Mining District, town of Sutter Creek, Amador County, is of peculiar interest. This vein, lead, or deposit is simply a large conglomerate of low-grade material, consisting of bunches and stringers of quartz intermixed with decomposed granite, slate, black gouge, and clay. All of this material, or stuff, as the owner terms it, on account of the impossibility of separating the good from the worthless, is passed through the mill. Sometimes bunches are found in the mass that are quite rich, yet a great portion of the deposit seems to contain but very little gold. There are no regular walls, nor any decided pitch to the formation. It was evidently thrown out, and to the east, from the chimney of ore composing the Lincoln and Mahoney Mines. An assay has never been made of the material, therefore there is no means of getting an average valuation. The owner's answer to the question as to yield, was characteristic and sensible: "I put through the mill large quantities of the stuff daily, and the clean-up, over and above expenses, is quite satisfactory." The claim is 400 feet long by 250 feet wide, with an average width of vein matter of 50 feet. The southeast end of the claim, 150 feet in length and 75 feet wide, is excavated to a depth of 80 feet. The excavating is still continued, and the whole mass passed through the mill. The mill, containing 40 stamps of 850 pounds each, with 7-inch drop of 85 times per minute, and crushing 4½ tons to the stamp in 24 hours, is run by water power. The batteries are low discharge with No. 6 slot screens, and the sluice plates, with an inclination of three quarters of an inch to the foot, are 16 inches wide by a length for each battery of 15 feet. The recovery of the gold is by amalgamation in the batteries and collection on the outside plates. There are no assays made of the tailings, consequently it is impossible to state the exact amount of recovery, but the owner gives it as about 60 per cent in the batteries and about 40 per cent on the outside plates. The sulphurets, iron pyrites, having an assay value of $60 per ton, are saved by concentration in the English buddle, and are treated by the chlorination process at the reduction works of Barney & Voorhies, Sutter Creek, at a cost per ton to the owner of $20.

Altitude, feet	1,280
Number of stamps	40
Weight of stamp, pounds	850
Drop of stamps, in inches	7
Drop of stamps, per minute	85
Duty of stamp in 24 hours, tons crushed	4½
Size of screens, slot	6
Miner's inches of water used in mill in twenty-four hours	100
Pressure of water, feet	260
Cost of mining, per ton	40 cents.
Cost of milling, per ton	20 cents.
Percentage of recovery saved in battery, about	60
Percentage of recovery saved on plates, about	40
Percentage of sulphurets	¾–1
Value of sulphurets, per ton	$60
Cost, per ton, of working sulphurets	$20
Number of men in mine	19
Number of men in mill	6
Length of ore-shoot, feet	400
Average width of vein, feet	50
Length of main tunnel, feet	400
Length of cross tunnels, feet	200
Depth of shaft, feet	150

MOORE MINE.

The mine is situated near the town of Jackson, in the Jackson Mining District, and at an altitude of 1,500 feet above the level of the sea. The course of the vein is southeasterly and northwesterly, with an easterly dip of 52 degrees. The claim is 3,200 feet long by 1,400 feet wide; length of shoot, 1,200 feet; average width of vein 16 feet, and explored depth, 500 feet. The hanging-wall is greenstone, and the foot-wall black slate. The ore, containing about 2 per cent of sulphurets, is what is termed free milling. The developments are, shaft 400 feet deep, three levels, varying in length from 200 feet to 400 feet, and a fourth level now being opened. The present explorations show an ore body 16 feet wide. The amalgamation is conducted in the batteries and by collection on outside plates. The sulphurets, iron pyrites, are recovered by concentration in buddles and worked for gold by the chlorination process at a cost of $15 per ton. The mill, run by water power, contains 10 stamps, weighing 850 pounds each, with a seven-inch drop, falling 90 times per minute, and crushes 3 tons per stamp every 24 hours. The plates, silver plated, are 48 inches wide and 20 feet in length to each battery. The hoisting works are run by steam. The developments during the year, to June twenty-seventh, are shaft 250 feet deep, two levels, and the retimbering of the old shaft. The ledge on the lower level is opening out so well in both size and quality, and the future prospects of the mine being so encouraging, the owners are taking into consideration the erection of a 40-stamp mill, and purchase of 16 Frue concentrators, and building of chlorination works.

Altitude, feet	1,500
Number of stamps	10
Weight of stamp, pounds	850
Drop of stamps, in inches	7
Drop of stamps, per minute	90
Duty of stamp in 24 hours, tons crushed	3
Size of screens, slot	6
Miner's inches of water used in mill every 24 hours	100
Pressure of water, feet	110
Cost of mining, per ton	$1 75
Cost of milling, per ton	$0 80
Percentage of recovery saved in batteries	50
Percentage of recovery saved in plates	35
Percentage of sulphurets	2
Value of sulphurets, per ton	$130 00
Cost per ton of working sulphurets	15 00
Number of men in mine	15
Number of men in mill	4
Length of ore-shoot, feet	1,200
Average width of vein, feet	10
Depth of shaft, feet	400

DOWNS MINE.

The mine is at Volcano, about twelve miles east of the mother lode, in the limestone belt region, and has an altitude of 2,250 feet above sea level. The course of the vein is northeasterly and southwesterly, with a dip of 77°. The dimension of the property is 600 feet wide by a length of 1,500 feet. The mine and machinery lay idle for some time, but at present everything above ground is in running order, and underground explorations are being carried on as speedily as possible. The property was located in 1877, and up to 1884, at which date work in the mine was discontinued, the gross receipts were $300,000—an average yield of $20 per ton. The hanging-wall is greenstone, and the foot-wall, on which lies a black putty-like

gouge one foot thick, is slate. On the property, beside the hoisting gear, is a 20-stamp, self-feeding, water-power mill; each stamp weighs 600 pounds, has a fall of 8 inches and a drop of 85 times per minute. The ore, excepting the small percentage of sulphurets, is free milling. About 75 per cent of the gold value is saved in the batteries, and about 20 per cent is saved on the outside plates. The sulphurets are recovered by means of blankets and buddles, and are ground and amalgamated in pan and barrel at a cost of $5 per ton. The apron plates are 24 by 50 inches, and the sluice plates are 16 inches wide, with a length, for each 10 stamps, of 35 feet, and an inclination of 1 inch to the foot.

Altitude, feet	2,250
Number of stamps	20
Weight of stamp, pound	600
Drop of stamps, in inches	8
Drop of stamps, per minute	85
Duty of stamp in 24 hours, tons crushed	1¼
Size of screen, slot	9 and 10
Miner's inches of water used in mill every 24 hours	28
Pressure of water, feet	520
Cost of mining, per ton	$3 00
Cost of milling, per ton	1 25
Percentage of recovery saved in batteries	75
Percentage of recovery saved on plates	20
Percentage of sulphurets	½
Cost per ton of working sulphurets	$5 00
Ore-shoots, two of 250 feet each and one of 60 feet, total feet	560
One shaft, feet in depth	433
One shaft, feet in depth	420
Width of vein, in feet	3-4

MAMMOTH OR NEVILL'S MINE.

This property is at Middle Bar, Jackson Mining District, at an altitude above sea level of 1,500 feet. The company's property embraces the mining claim, with an area of 2,206 feet in length by 500 feet in width, and 120 acres of timber land adjoining. The course of the vein is northwesterly and southeasterly, with an easterly dip of 75°, and an average width of 8 feet. The mine is worked through a tunnel, 3,500 feet in length by 8 feet square in the clear, which taps the vein at a depth of 800 feet from the surface. The hanging and foot-walls are greenstone and slate respectively. The sulphurets, arsenical, of which there are 4 per cent, with an assay value averaging $1,500 per ton, are recovered by buddle concentration, and worked by the chlorination process at a cost of $20 per ton. The mill contains 10 stamps, each stamp weighing 750 pounds, with a fall of 8 inches, and a drop of 90 times per minute. Water is the motive power of the mill, 70 inches being used, with a pressure of 750 feet. The plates are 52 inches wide by a length of 25 feet for each battery. At times very rich ore occurs in the vein, especially where the matrix contains a large percentage of arsenical pyrites. This ore, so largely impregnated with native gold, is reduced in the hand mortar. The developments, beside those above mentioned, are 1,600 feet of drifts, 220 feet of uprise, and 40 feet of winze, still sinking in the same rich class of ore as is worked in the hand mortar.

Altitude, feet	1,500
Number of stamps	10
Weight of stamp, pounds	750
Drop of stamps, in inches	8
Drop of stamps, per minute	90
Duty of stamp in 24 hours, tons crushed	2½
Size of screen, slot	6

Miner's inches of water used in mill, in 24 hours	70
Pressure of water, feet	750
Cost of mining, per ton	$2 00
Cost of milling, per ton	1 00
Percentage of recovery saved in batteries	30
Percentage of recovery saved on plates	20
Percentage of sulphurets	4
Value of sulphurets, per ton	$1,500
Cost per ton of working sulphurets	$20
South ore-shoot, in length, feet	300
North ore-shoot, in length, feet	600
Tunnel, in length, feet	3,500
Number of men in mine	13
Number of men in mill	2
Average width of vein, feet	8

Loyal Lead Mine, near Drytown. Ore is being crushed which averages between $7 and $8 per ton in free gold.

Mr. Mason has a very encouraging quartz prospect near Volcano; there is a well defined ledge in the tunnel, showing free gold in paying quantities.

Marlette Mine. A ditch is being constructed, to carry 100 inches of water, from the Amador Canal to the mine. Hoisting works are being erected in the tunnel, for the purpose of sinking a winze. The works are to be run by water power.

Bunker Hill. Twenty of the forty stamps are being run on the new find at the 700-foot level, and the chlorination works are in full operation.

Gover Mine is running twenty stamps on rock found north of the old shaft.

Volcano Gold Gravel Mining Company, made a clean-up for the season's run of over $19,000.

Mahoney Mine, Sutter Creek. The company commenced operations above ground, and the mill will be started on surface dirt.

The new forty-stamp mill at the Kennedy Mine is near completion, and in a very short time the stamps will be crushing ore from the mine.

ZEILE MINE.

This mine is situated in Jackson Mining District, at an altitude of 1,300 feet above the level of the sea, in a slate formation. The vein has an easterly dip, a nearly north and south course, and averages 30 feet in width, ore and vein matter included. The claim occupies 1,600 linear feet on the lode, and is worked through a nearly perpendicular shaft to a depth of 885 feet. Formation of the hanging wall is metamorphosed slate, and that of the foot-wall is soft blue slate with a gouge of decomposed talc, from a few feet to fifty feet thick.

The product of this mine demonstrates how low a grade of ore may be worked to a profit, when done systematically. The ore, when carefully assorted, with free gold and sulphurets, assays but $4 per ton. After the recovery of the free gold in the batteries, and on the outside plates, the sulphurets are saved on the Frue vanner, and are worked by the chlorination process, at the company's works.

The motive power of the machinery is water, but a steam plant is kept in place, to be used when circumstances require.

The mill contains forty stamps, of 750 pounds weight each, falling 7½ inches, with a drop of 88 times per minute, and each stamp crushing 3.37 tons every 24 hours.

The plates are: Battery, 6 by 50 inches; aprons, 30 by 58 inches; and sluice, 16 inches wide by 144 inches long; with the respective inclinations of 3, 2¼, and 1¼ inches to the foot.

Altitude, feet	1,300
Number of stamps	40
Weight of stamp, in pounds	750
Drop of stamps, in inches	7½
Drop of stamps, per minute	87–88
Duty of stamp in twenty-four hours, tons crushed	3.37
Percentage of sulphurets	2½
Value of sulphurets, per ton	$100 00
Number of men in the mine	90
Number of men in the mill	5
Total number of men employed in and about mine	115
Depth of shaft, in feet	885
Average width of vein, in feet	30
Number of concentrators	16
Miner's inches of water used for stamps and concentrators in 24 hours	190
Pressure of water, in feet	150
Length of ore-shoot, in feet	400

WORKING LOW BEDS OF GRAVEL.

The following description of a method of working low beds of gravel we take from the *Mining and Scientific Press* of San Francisco:

A few miles from Ione, Amador County, in this State, is the Arroyo Seco Mine, which, as the Spanish name indicates, is situated in the bed of a "dry creek." The ground was known to be rich, but all attempts to work it failed, until J. P. Lambing took hold of the operation. The difficulty was there was no fall, and no way of getting rid of tailings. The pay dirt is about five or ten feet deep, and there is considerable stripping to do.

In order to get rid of the worthless top dirt, there is a large crane or steam derrick. The two engines to operate this are 9x16 inches, and there are two 48-inch upright boilers. They hoist from five to seven tons at a load, on the end of a boom 110 feet long. The dirt is hoisted fifty feet high, swung to one side and dumped, and the tub returned in one and a half minutes. The derrick house, containing the engines and boilers, is on tracks laid on the ground, so that it can be gradually moved up the creek as the claim is worked. With this derrick they can dump the "strippings" 110 feet on each side of the center, allowing the men to get the pay gravel.

Mr. Lambing states that this boom is much easier handled and controlled than those built by the Lakeport Derrick Company builders, who have the reputation of making the best, and it works in every way as well, and in many respects better, than those built in the Eastern States. Mr. Lambing went East to examine all there were and ascertain prices, but resolved to have his made here. In addition to the engineer one man controls the movement of the bucket and derrick, and one man on the boom attends to the dumping.

The pay dirt is washed in sluices, as shown in the engraving. The tailings, small rocks, sand, and water run into a general sump under the tall house shown in the accompanying engraving. Now these tailings and the water have to be removed, as there is no fall and no way to get rid of them except to hoist them out of the way. This is accomplished in a very simple but ingenious manner.

In the sump are two submerged centrifugal pumps, of peculiar pattern, and designed for this particular work. Each has two 11-inch discharge pipes; the capacity is 600 miner's inches of water, or 900 cubic feet per minute. These pumps have no steps or bearings made under water, the whole weight resting on two 26-inch anti-friction wheels.

On the floor above these centrifugal wheels are two 15-inch Knight water wheels fed from the main supply pipe with 68 feet head. These wheels run the submerged centrifugal pumps below and raise the sand, gravel, and water from the sump, throwing the whole debris and water into the flume seen issuing from the side of the pump-house. From this flume the gravel and rocks are shoveled out by men, the water is screened and again returned by a pipe, to be used in sluicing. Sixty-eight feet of water does the washing, pumping, and all.

These 15-inch Knight turbine wheels are giving great satisfaction. Mr. Lambing states that they were formerly running one No. 6 and one No. 8 vertical centrifugal pump with a 12-foot wheel of another pattern under 68 feet head, and 400 inches of water. They had to raise from 100 to 500 miner's inches 36 feet high, but the wheel required too much water, and the pumps so much care the present plant was substituted. Mr. Lambing has been mining for the past 34 years and used all the wheels, but he now has five Knight wheels in use, preferring them to others. This centrifugal double discharge pump will pump sand, gravel, chips, leaves, or anything that will pass through a three-inch mesh.

They have pumped up with the water sand and fine gravel as fast as two men could shovel it to the pump for hours at a time and raised it 36 feet high. These pumps have been in constant use for the past two years and it can not be seen that they are any the worse for the hard usage, though the pumps brought out from the East wore out in five months doing the same work.

There is a large amount of mining ground throughout the Pacific Coast, similar to that at the Arroyo Seco Claim, where the stripping is too deep to admit of working by the old process, but which can be perfectly worked by using these powerful steam derricks to remove the strippings. It is fortunate for the mining interests that these can be built here at the mines, and at no greater cost than they can be had from the East. This whole plant was made by Knight & Co., Sutter Creek, E. A. Rix & Co., agents, No. 20 Fremont Street, this city. Miners who know of ground of a similar character to that described will do well to note the success achieved at Arroyo Seco.

BUTTE COUNTY

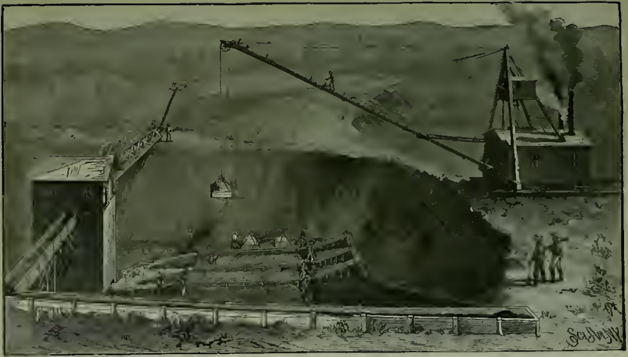
Is bounded on the northwest by Tehama, on the northeast by Plumas, on the southeast by Yuba, on the south by Sutter, and on the west by Colusa Counties. Owing to the exhaustion of the surface placers and discontinuance of hydraulicking, the mining community is thinning out, and the county is falling behind as a gold-producer. Some of the former hydraulic miners have had recourse to drift mining, but the expense is so great by the latter method that they have met with but little, if any, financial success. The geological structure in the gold-bearing section of the county is composed of metamorphic slates, sandstone, and granite. The lava bed region is largely conspicuous in the county.

At Oroville, in Feather River, a company is experimenting in working the river bed through a tubular pile, on the pneumatic principle. The miners complain, whilst subjected to the atmospheric pressure, of a depressive feeling, or lassitude, and a buzzing in the head and ears, more particularly so in the latter case when having a slight catarrh. So far the work is entirely experimental, and we await the result of the undertaking with no little anxiety.

There are a few lone miners drifting in the banks of Butte Creek; but so far none are making anything beyond reasonable wage-hire.

SPRING VALLEY HYDRAULIC GOLD MINE,

Is located at Cherokee, on the north end of Table Mountain, which is crowned by a layer of basalt between 80 and 100 feet deep. The altitude of the mine at bedrock is 1,000 feet. It is one of the largest hydraulic mines in the State, and one of the few in active operation, most of the others having been enjoined by order of the Courts. The average depth, from surface to bedrock, is about 500 feet, by 1 mile in length, and lies in part under Table Mountain, without regard to the conformity of the region in which it exists. In its early history the mine was surface worked by individual locators who held claims, according to the mining laws of the district, of 100 feet square to each locator, and the gold was recovered by means of rockers, long toms, and sluices, respectively, as they succeeded each other, but since 1858 the work has been exclusively hydraulicking. Up to the year 1870 the water supply consisted solely of the drainage of about 10 square miles of territory, on account of the property being isolated from the Sierra Nevada Range by a deep gorge of the Feather River. At this date Egbert Judson and other capitalists interested themselves with H. B. Lathrop, and built reservoirs, constructed ditches, and laid iron pipe across the above mentioned gorge, 30 inches in diameter, 13,100 feet in length, with a perpendicular depression from the grade line of 902 feet. Most of the engineers, looking upon the undertaking as a successful impossibility, advised capitalists not to invest. It is now 16 years since the pipe was placed in position, and work has been carried on without interruption, and with very little cost for repairs; this



Mining Low Ground Without Fall, at Arroyo Seco, California.

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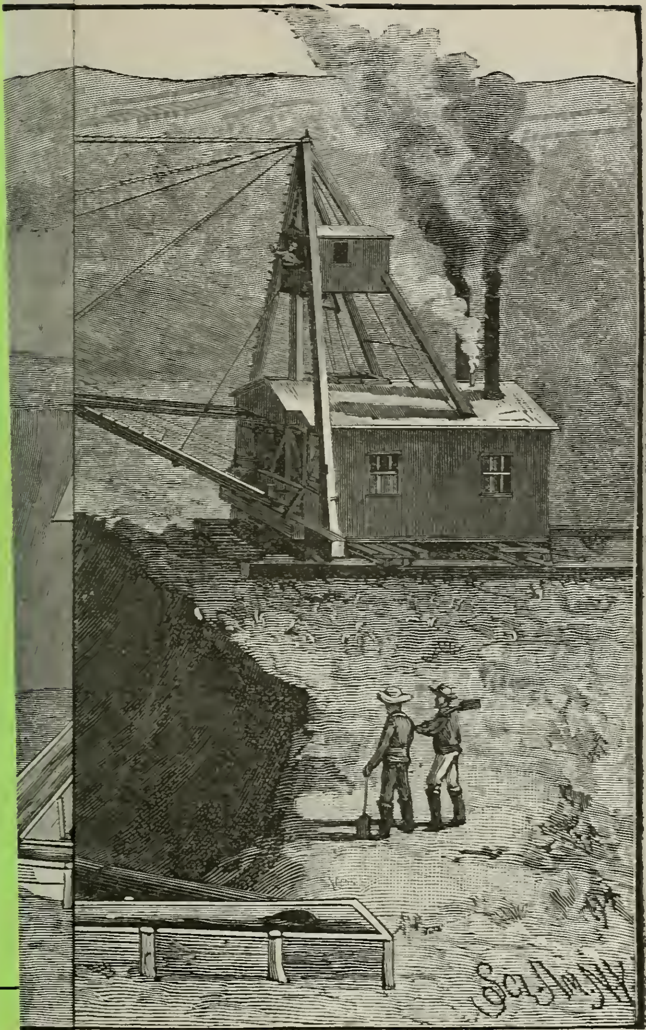


pipe furnished 2,210 inches of water every 24 hours for about 8 months of the year. Three years later, to secure a yearly supply of water, additional reservoirs and ditches were constructed, and a pipe, 30 inches in diameter, 3,780 feet in length, with a vertical depression of 630 feet, was laid. The blue gravel, from 10 to 50 feet in depth, lying on the bedrock, carries the greater quantity of gold; thence comes a layer of bowlders, apparently a separate flow, from 3 to 15 feet deep, the most valuable stratum in the mine, yielding from $1 to $8 per cubic yard, and can be removed by hydraulic streams solely: above, intermingled with layers of pipe-clay, is a deposit of fine white quartz gravel and sand, from 20 feet to 400 feet thick. In some parts of the mine the banks have a perpendicular face of 450 feet in height, and it is not an unusual occurrence in the caving for the debris to bury pipes, throwing a 7-inch stream, in position 400 feet distant. The portion of the ground containing the greater amount of gold to the cubic yard was exhausted prior to 1870, and although there are no data to approximate the yield, it is estimated at an excess of $5,000,-000. The value of the gold recovered from 1870 to July, 1886, amounted to the sum of $5,008,208 62; for the same period the expenditures were as follows:

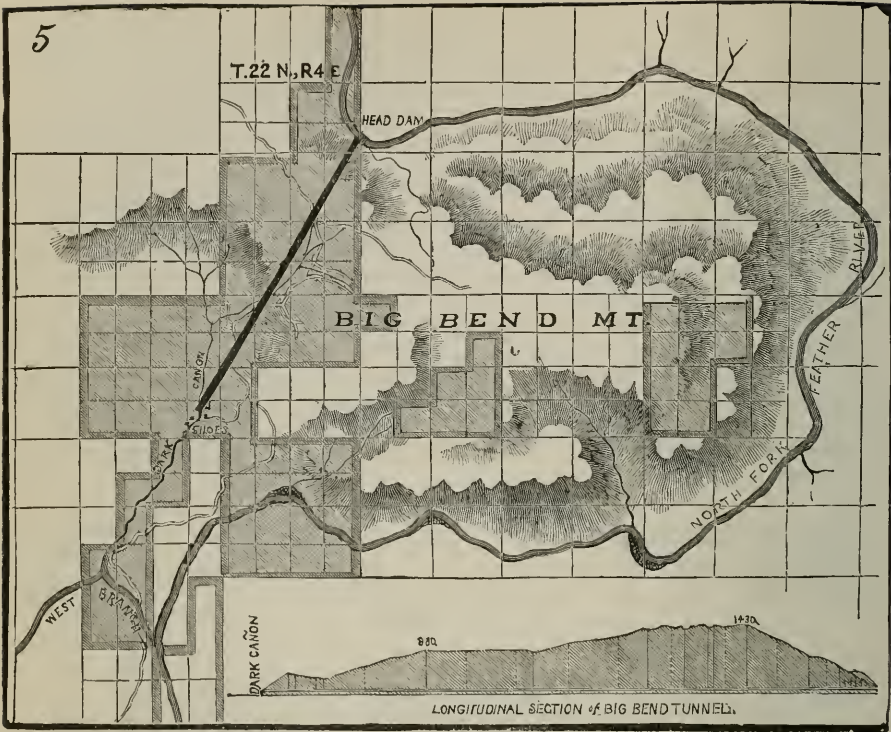
Reservoirs, ditches, and pipes	$510,820 59
Mining plant and tunnels	199,780 55
Mining ground purchased	419,396 18
Land purchased	461,435 87
Cost of debris canal	270,811 48
	$1,862,244 67

Mining expenses, including care and repair of ditches, $1,759,953 77.

The company's water is drawn from nine reservoirs occupying an area of 522 acres, passed through 94 miles of water ditches and 20,940 feet of 30-inch wrought-iron pipe. Among the items enumerated under expenditures, the amounts $461,435 87 for land purchased, and $270,811 48, cost of debris canal, is the actual expense of impounding the tailings. Much of the land originally purchased has since been sold, and about one half its cost has been recovered, yet there is still enough swamp land in possession of the company on which to convey the debris to outlast the mine. The slickens flow through a canal 32 miles long, to two restraining dams 1,800 feet wide, and 12,000 acres of tule land. The mine is worked day and night, 240 men being employed, the after dark illumination being furnished by two 8,000 candle power electric lights.

THE BIG BEND TUNNEL.

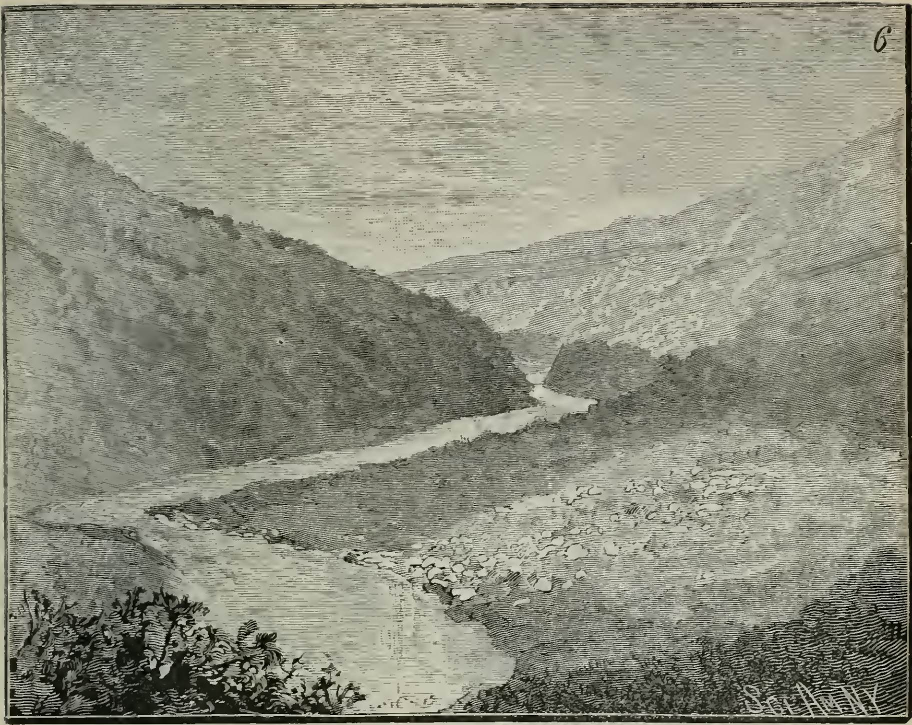
This undertaking is without a parallel among the mining ventures of the State. The bend from which the water is to be diverted has a trend not very unlike a horseshoe, with a length, following the meanderings of the water flow, of 13 miles. The purpose for which the tunnel was constructed is to convey the waters of the North Fork of Feather River from their natural course to the tributary of the river's west branch, thereby leaving bare the channel of that portion known as the Big Bend.



Map Showing Tunnel and Big Bend of Feather River.

At the time the water flow was measured, and almost to the period of the tunnel's completion, the quantity was less than for several years previous; consequently the tunnel has not the capacity to accommodate the present body of water confined within the river's banks, and it must, therefore, necessarily be enlarged to add success to the undertaking. The stockholders, however, feel in nowise low-spirited over the present condition of affairs, but look hopefully forward to the expiration of the few months necessary for the required enlargement, when they expect the river bed to yield its auriferous treasure. It is impossible, on account of the steep banks and their rocky formation, to divert the stream in any other way, that will promise a reasonable recompense, than the method adopted. The amount of precious metal concealed by this watery blanket is as yet an unknown quantity, but it is to be hoped that an enterprise so unique and so unwaveringly carried out should receive the reward it so meritoriously deserves.

On account of the formation through which the tunnel passed, slates, granite, quartz, and diorite, there were but few places necessary to secure by masonry. The mouth of the tunnel is in Dark Cañon, near the southeast corner of section eleven, township twenty-one north, range four east. From this point the tunnel runs north, 29° 30′ east, 12,007 feet, to where it taps the North Fork of Feather River. The tunnel, as it is, is 16 feet wide by 9 feet high, with a grade of 30 feet per mile, with the exception of at the head, where for 200 feet, to insure the filling, there is an increased grade. The company will at once commence the work of enlargement, to increase



View off Island Bar, Feather River.

the carrying capacity to 120,000 miner's inches of water. At the inlet, for the purpose of preventing or admitting the water flow, are 6 ponderous iron gates, worked by screws and wheels. A permanent dam, 200 feet long and 16 feet high, is in course of construction across the river just below the inlet. The dam is being built of large timbers, securely fastened to the bedrock and bolted together, after which it will be filled with rocks and covered with heavy planks. A flume for carrying the present surplus of water, not taken by the tunnel, is built from the dam down the river to a distance of 1,007 feet. This flume, 3 feet deep and 18 feet wide, carries a body of water 18 inches in depth with a flow of 10 feet per second. Along this flume the channel is bared sufficiently to allow prospecting of the river bed. Work on the tunnel began in July, 1882, and the water was turned therein in July, 1886. The cost thus far, as near as can be approximated, is $750,000.

CALAVERAS COUNTY.

The county is bounded on the northwest by Amador, on the northeast by Alpine, on the southeast by Tuolumne, and on the southwest by Stanislaus and San Joaquin Counties. Bear Mountain Ridge, a belt of metamorphic rocks, strikes northerly across the central portion of the county, reaching from the Stanislaus River to the vicinity of Calaveras River, separating the copper belt from the auriferous slates. The limestone belt

enters the southwestern part of the county, from Tuolumne, and is more extensively exposed at Murphy's.

At Angels the exploitation is on the auriferous belt about 200 feet to the east of the mother lode; it is a large vein, in talcose slates, but low grade.

THE STICKLES GOLD QUARTZ MINE

Is located in Angels' Mining District, at the north end of Angels' Camp, at an altitude of 1,800 feet above sea level. The dimension of the claim is 300 feet by 600 feet; the course of the vein is northwest and southeast, having a dip of 90° to the east and an average width of 12 feet.

The mine is worked through a three-compartment shaft 400 feet deep, the vein showing at all points. Upon the property is a wet crushing mill of 20 stamps, each stamp weighing 900 pounds, having a 7-inch fall, a drop of 80 times per minute, and crushing 3¾ tons of ore every 24 hours. Seventy per cent of the yield is recovered by amalgamation in the battery, and 30 per cent is collected on the outside plates. The sulphurets, averaging 2 per cent of the ore, are saved by Cornish buddles, and have an assay value of $120 per ton. Hoisting and pumping are done by steam power. The sluice plates, silver plated, are 4 feet wide, 11 feet long, and have an inclination of 1¾ inches to the foot. Developments in the mine consist of four levels at 60, 200, 250, and 400 feet deep, respectively. The level at the depth of 60 feet runs north and south from the shaft, in each direction 30 feet; at 200 feet the level runs south 150 feet, north 200 feet; the 250-foot level has the same course and a corresponding distance, north and south of the shaft, as the 200-foot level; the 400-foot level runs 200 feet north from the bottom of the shaft; all of these levels are on the vein, which has not been stoped out anywhere more than 30 feet above the levels.

Altitude, feet	1,800
Number of stamps	20
Weight of stamp, pounds	900
Drop of stamps, in inches	7
Drop of stamps, per minute	80
Duty of stamp in 24 hours, tons crushed	3¾
Size of screen, slot	9
Percentage of recovery saved in batteries	70
Percentage of recovery saved on plates	30
Percentage of sulphurets	2
Value of sulphurets, per ton	$1 20
Cost of mining, per ton	1 50
Cost of milling, per ton	75
Number of men in mine	24
Number of men in mill	6
Depth of shaft, vertical, feet	400
Length of ore-shoot so far as developed, feet	400

THE UTICA MINE,

Angels, Angels Mining District. The claim is 300 feet wide by a length of 634 feet. The course of the vein is northwest and south, dipping 85 degrees to the east, and averaging in width 20 feet. The 20-stamp mill has both water and steam power. Each stamp weighs 950 pounds, drops 8 to 9 inches at the rate of 80 times a minute, and crushes 3 tons of ore every 24 hours. The plates, with an inclination of 1¼ inches to the foot, are 52 inches wide and 10 feet in length to each battery.

Number of stamps	20
Weight of stamp, pounds	950
Drop of stamps, in inches	8-9
Drop of stamps, per minute	80

Duty of stamp in 24 hours, tons crushed	3
Size of screens, slot	9
Percentage saved of recovery in battery	75
Percentage of recovery saved on plates	25
Percentage of sulphurets	2
Percentage of sulphurets, per ton	\$60 00
Cost of mining, per ton	\$2 50
Cost of milling, per ton	\$0 60
Depth of shaft, feet	140
Miner's inches of water used in 24 hours	150
Pressure of water, feet	100
Number of men in mine	25
Number of men in mill	6

ANGEL'S GOLD MINE.

This mine, in Angel's Mining District, has not been worked for the past few months, but will shortly be again in active operation; in fact, preparatory steps have already been taken to commence work. The claim is 1,354 feet in length, by a width of 600 feet. The vein, with a north and south course, is 20 feet wide, and has an easterly dip of 15 degrees. The developments consist of two shafts 100 feet, each, in depth and 300 feet apart, connected by a level. The improvements are, two J. B. Low mills, each having a capacity of 20 tons in 24 hours, two hoisting plants, pump, air-compresser, and four Frue vanners.

DEEP LEAD PLACER MINE,

In Mokelumne Hill Mining District, was located in 1880, and has been worked continuously ever since. During the first year an incline was sunk 380 feet, to the channel, which is vertically 130 feet from the surface. Since then the developments are 2,600 feet along the channel, besides sixteen crosscuts, of an average length of 50 feet each. The perpendicular depth from the surface to the face of the present workings is about 425 feet. The course of the channel is north and south, having a width varying from 40 to 60 feet, and in length about one and a half miles. The improvements consist of an 8-stamp water-power mill, three hurdy-gurdy wheels, one being 4 feet and two being 6 feet in diameter; one water-power hoist, and one 6-inch by 5-foot stroke plunger pump. Of the water, which has 225 feet pressure, there is used for the mill 20 miner's inches, and 12 miner's inches each for the hoist and pump every 24 hours. Five per cent of the gold recovered is by the batteries and ninety-five per cent on the outside plates. Each stamp weighs 750 pounds, falls 9 inches, at the rate of from 85 to 87 times per minute, and crushes five carloads of gravel every 24 hours. Developments during the year are 700 feet of tunnel and four crosscuts of 5 feet each.

Number of stamps	8
Weight of stamp	750
Drop of stamps, in inches	9
Drop of stamps, per minute	85–87
Duty of stamp in 24 hours, carloads crushed	5
Size of screen, steel wire, meshes to the inch	5
Average value, per carload	\$1 00
Percentage of recovery saved in batteries	5
Percentage of recovery saved in sluices	95
Number of men in mill	1
Number of men in mine	5
Miner's inches of water used in 24 hours:	
For mill	20
For hoist	12
For pump	12
Pressure of water, feet	225

SHEEP RANCH MINE.

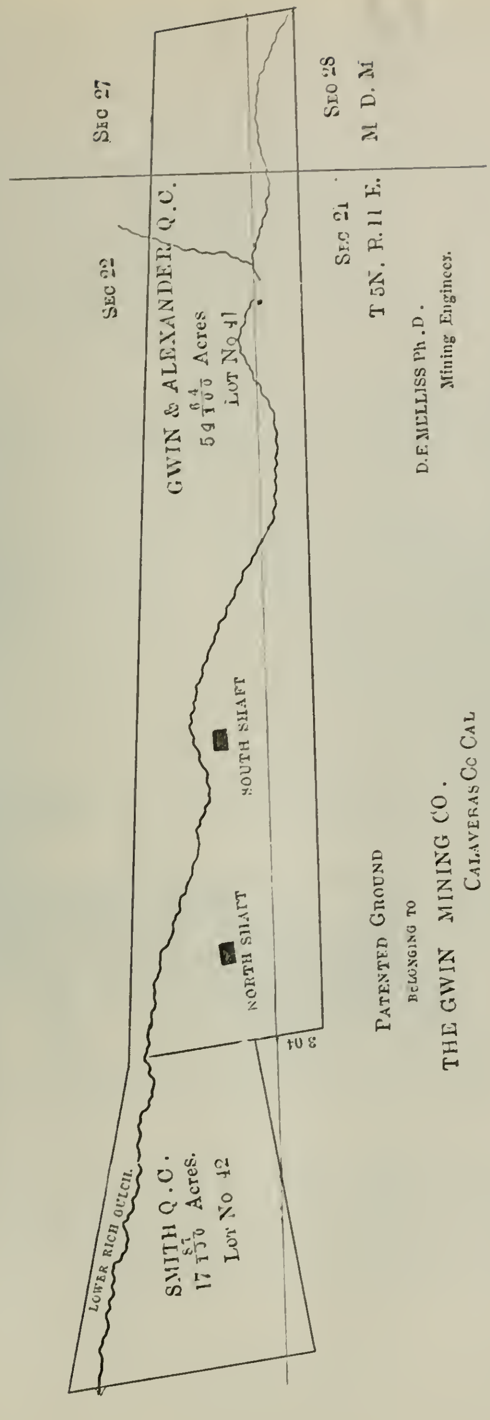
This, the principal mine in the Washington Mining District, is situated on San Antonio Creek, a tributary of the Calaveras River, at an altitude of 2,200 feet above sea level, in a slate formation. The claim is 1,600 feet in length by 200 in width; course of the vein northwesterly and southeasterly; dip easterly, and average width 12 inches. Hanging-wall is a grayish slate and foot-wall a hard black slate; the ore is a ribboned, free milling quartz. All the ore has been taken out down to the 800-foot level; the mill is at present crushing rock from the above and the 900-foot levels. During the year the shaft has been continued down 100 feet and 1,000 feet of levels have been run. The mill, wet crusher, 30 stamps, is run by steam power; each stamp weighs 800 pounds, falls 8 inches 85 times per minute, and crushes 2¼ tons of ore every 24 hours. Eighty per cent of the recovery is obtained from the batteries and 20 per cent is collected from the outside plates. The sulphurets are so low in value that it is not worth the while to save them. The apron plates having an inclination of 2 inches per foot, are 4 by 10 feet, and the sluice plates inclining 1½ inches to the foot are 15 inches wide, with a total length of 100 feet.

Altitude, feet	2,200
Number of stamps	30
Weight of stamp, pounds	800
Drop of stamps, in inches	8
Drop of stamps, per minute	85
Duty of stamp in 24 hours, tons crushed	2¼
Average width of vein, in feet	1
Depth of shaft, in feet	900
Length of ore-shoot, in feet	1,200
Size of screens, diagonal slot No.	9
Percentage saved of recovery in batteries	80
Percentage saved of recovery on plates	20
Cost of mining, per ton	$3 00
Cost of milling, per ton	$4 00
Number of men in mine	40
Number of men in mill	7
Brakemen, blacksmiths, teamsters, etc.	18

THE GWIN MINE.

The following description is contributed by D. Ernest Melliss, Ph.D., Mining and Civil Engineer, as a record of deep mining on the gold belt of California:

The mine is situated in the Mokelumne Hill or Middle Bar Mining District, six miles north of Valley Springs, Calaveras County, at an altitude of 1,300 feet above the sea. The property comprises two United States patent claims, contiguous to each other, as shown in the accompanying map. These claims cover 4,989 feet, lineal, on the mother lode, with a total surface area of 69.61 acres. The mine was taken up by the late Senator, Wm. M. Gwin, in 1867; he purchased the Alexander Mine in 1872, and the Smith Mine in 1881; the property was incorporated under the name of the Gwin Mining Company.


Sec 27
Sec 28
M D. M
Sec 22
GWIN & ALEXANDER Q.C.
59 64/100 Acres
Lot No 41
Sec 21
T 5N. R. 11 E.
D.E. MELLISS Ph.D.
Mining Engineer.
SOUTH SHAFT
NORTH SHAFT
304
Patented Ground
Belonging to
THE GWIN MINING CO.
Calaveras Co Cal
SMITH Q.C.
17 87/100 Acres.
Lot No 42
LOWER RICH GULCH

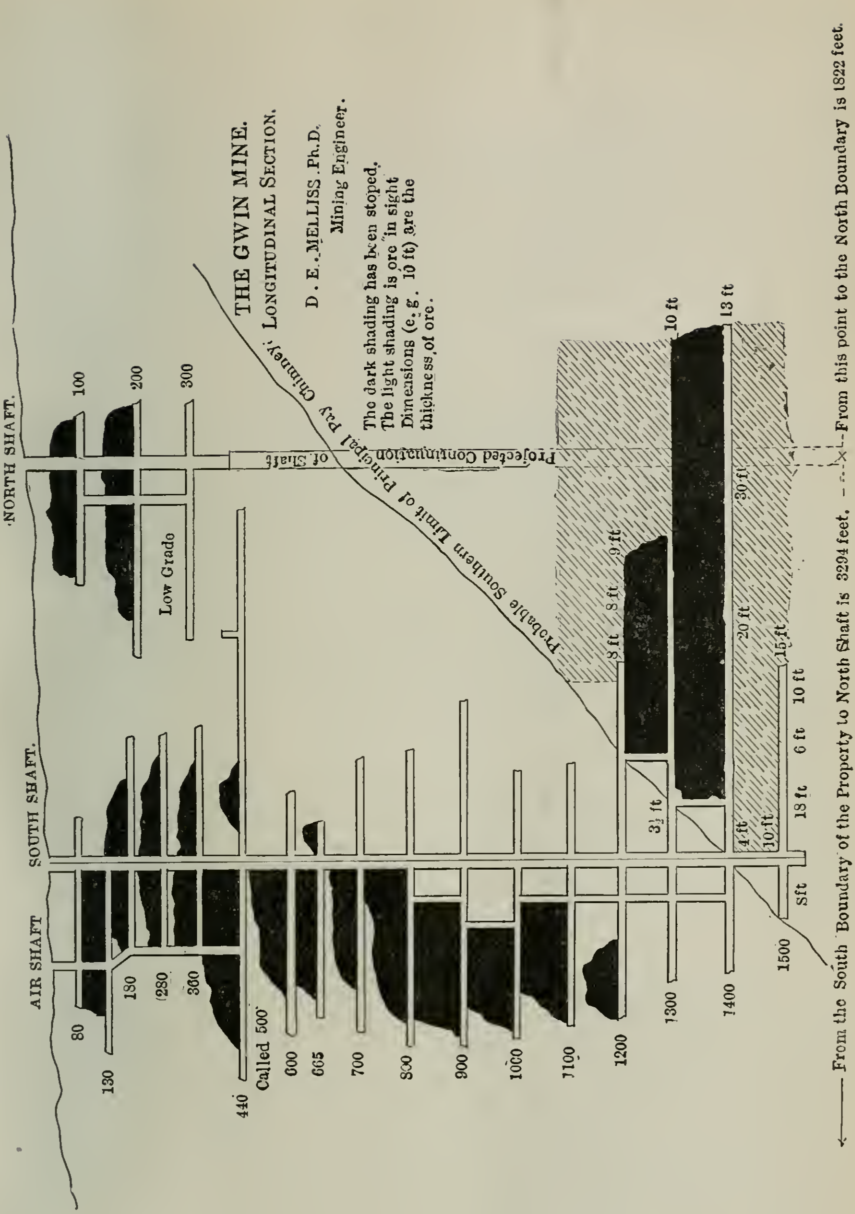
The country rock is slate; the vein strikes nearly due north, true meridian, and dips 75° to 80° to the east. The ore in the mine is white and banded quartz, carrying free gold and auriferous iron sulphurets, with occasional admixture of blende and galena. The average value in free gold is about $8 per ton of ore, although, at times, exceedingly rich bunches of auriferous quartz have been found. The sulphurets are about one and one half per cent of the ore, and the value of the concentrations is about $100 per ton. The retorted gold ranges in fineness from 850 to 875. The south shaft (see accompanying longitudinal section) has been sunk to a depth of 1,530 feet. It is an incline, and follows the foot-wall of the vein. Prior to 1877, considerable ore was taken out from the different levels above the 1,200. In April, 1877, the main ore chimney was struck, and it is on the character of this chimney, as developed by the workings in the 1,200, 1,300, 1,400, and 1,500 levels, that the value of the mine now depends.

The 1,200 level, which has been driven 370 feet to the north, strikes the pay chimney 160 feet from the shaft. No stoping of the north ore body has been done above this level. Of this level, 110 feet are in pay quartz, which is 3 feet thick at the commencement, and widens to 8 feet at the breast.

In the 1,300-foot level the chimney is struck 100 feet from the shaft; the level has been driven to a distance of 640 feet, of which 540 feet was in ore; at the breast it is 13 feet thick. The ground between the 1,300 and 1,400 levels has been taken out, as shown; the top of the stopes on the 1,200 line showing 8 to 9 feet of ore. At the 1,400 level the shoot crosses the shaft; the level has been driven 1,040 feet, all in pay ore; stoping has been done to the 1,300 level, as shown. The ore was 5 feet at the shaft, but in the length of the level widened once to 20 feet, again to 30 feet, and is 13 feet at the breast. The 1,500 level has been driven 100 feet to the south, and 370 feet to the north, all in pay ore. At the south breast the limit of the ore body in that direction has been reached; at that point it is 5 feet thick; at the north breast the ore is 15 feet thick, at the shaft 10 feet, and between that point and the north end it varies between 6 feet and 18 feet.

The mine has produced in all, over $2,000,000 of gold. The exact amount cannot be ascertained. From partial records in possession of the owner, one is enabled to glean the following details in regard to the bullion product. It may be remarked incidentally that the mine was carried on always as a family concern, the money was distributed every month as fast as procured, and no surplus was ever allowed to accumulate. Prior to 1877 no care was taken to make or preserve any records. No records at all for the years from 1867 to 1871 existed, although 40 stamps were constantly running. From April, 1877, till September, 1881, the greater portion (but not all) of the gold produced was deposited in the Pacific Bank of San Francisco.

There are records of weekly shipments of bullion (with some intervals) extending over the period from April 7, 1871, to August, 1882. In none of these statements is the bullion from sulphurets included, except in one instance, a shipment on December 24, 1874, in amount $11,565. The summary of these data is shown in the following table:


THE GWIN MINE.
LONGITUDINAL SECTION.
D. E. MELLISS, Ph.D.
Mining Engineer.
The dark shading has been stoped.
The light shading is ore in sight
Dimensions (e. g. 10 ft) are the
thickness of ore.
AIR SHAFT
SOUTH SHAFT.
NORTH SHAFT.
80
130
180
280
360
440
Called 500
600
665
700
800
900
1000
1100
1200
1300
1400
1500
100
200
300
Low Grade
Projected Continuation of Shaft
Probable Southern Limit of Principal Pay Chimney
8 ft
8 ft
9 ft
3½ ft
10 ft
13 ft
4 ft
20 ft
30 ft
10 ft
15 ft
5 ft
18 ft
6 ft
10 ft
From the South Boundary of the Property to North Shaft is 3294 feet.
From this point to the North Boundary is 1822 feet.

3 mi

PARTIAL STATEMENT OF BULLION FROM GWIN MINE.

Date.	Part of Mine.	Amount.
April, 1871, to June 26, 1872	400 level	$90,353 00
July 8, 1872, to December 26, 1872	500 level	53,808 00
January 1, 1873, to October 5, 1873	600 level	118,551 00
November 25, 1873, to February 15, 1874	700 level	29,214 00
April 26, 1874, to August 30, 1874	800 level	81,516 00
September 25, 1874, to April 8, 1875	900 level	73,509 00
April 19, 1875, to June 24, 1876	1,000 level	80,012 00
January 30, 1876, to March 26, 1877	1,100 level	135,338 00
April 12, 1877, to October 1, 1879	1,300 and 1,400 level	446,349 00
October 9, 1879, to September 23, 1881	Above the 900 level	259,413 00
December 3, 1881, to August 4, 1882	Above the 900 level	31,083 00
Total		$1,399,146 00

The mill and hoisting works were old and entirely worn out. There were two quartz mills, one of 36 and one of 24 stamps. The stamps weighed only 500 pounds, dropping 75 times per minute. The mortars were old fashioned. The concentrators were concave buddles and sluice boxes. The 60 stamps did not have the crushing capacity of a modern 40-stamp mill. Furthermore, although there are no records relating to the subject, the character of work done in saving gold must have been very poor.

No steam is required for power either for mill or hoisting works. The Mokelumne Hill and Campo Seco Water Company's ditch passes above the mine, giving 300 feet head at the hoisting works delivered through a pipe 100 feet long. To pump and hoist from the 1,500 level, and run 60 stamps, required 180 miner's inches. The cost is about 16 cents per 24-hour inch.

Regarding the water in the mine, no difficulty was ever experienced in keeping it under control till the 1,400 was reached, with a 5-inch pump 30-inch stroke, running 8 strokes per minute. At the 1,500 a slightly increased amount was met with which the same pump could have controlled were it possible to increase the speed; this, however, could not be done, owing to the crooked condition of the shaft.

FINE GOLD MINE.

The mine is situated at an altitude of 3,000 feet above the level of the sea, in Railroad Flat Mining District, and is 1,500 feet in length by 600 feet wide. The course of the vein is north and south, dipping 70 degrees westerly, and averages 5 feet in width. The hanging and foot walls are slate, and the quartz is free milling, containing about 2 per cent of sulphurets, but not of sufficient value to pay for collecting and working. Developments on the property, beside the shaft 250 feet in depth, are three levels running north and south on the vein, from 400 feet to 600 feet in length, all of which were made during the year 1886. The machinery consists of water power, 10-stamp mill, hoisting works, and air compressor. The stamps weigh 750 pounds, drop 7 inches 100 times per minute, and crush 21 tons of ore per day. The apron plates are 4 by 4½ feet, and the sluice plates are 16 inches wide by a length of 100 feet to each battery. The saving of the yield is about equally divided between the batteries and plates.

Altitude, feet	3,000
Number of stamps	10
Weight of stamp	750
Drop of stamps, in inches	6
Drop of stamps, per minute	100
Duty of stamp in 24 hours, tons crushed	$2\frac{1}{10}$
Size of screens, mesh	40
Miner's inches of water used in 24 hours in mill	35
Miner's inches of water used in 24 hours in hoisting works	35
Miner's inches of water used in 24 hours in compressor	35
Pressure of water, in feet	300
Cost of running, per ton	$4 00
Cost of milling, per ton	$1 00
Percentage of recovery saved in batteries	50
Percentage of recovery saved on plates	50
Number of men in mine	39
Number of men in mill	3
Total number of men employed in and about mine	47
Depth of shaft, in feet	250
Length of ore-shoot, in feet, so far as explored	200
Average width of vein, in feet	5

WILLARD MINING COMPANY.

(Contributed by F. B. Morse, E.M.)

The property belonging to the Willard Mining Company is situated in Calaveras County.

Murphys Mining District.—The altitude is about 2,200 feet above sea level. The formation is limestone and slate. The accompanying sketch marked Fig. 1 is a diagram of the formation; the line marked cc'cc being the line of contact. The apparent stratifications of the slate and limestone are conformable and run nearly east and west, the line of the contact cutting the formation. The positions of the different veins are also shown in this diagram. They consist apparently of a main opening, marked AA, and small side veins, marked BB, DD, etc., running into the main opening on either side.

The main vein, AA, is called the "Red Wing" vein. The dip of this vein, as far as known, is nearly vertical; course about 15° north of west and south of east. The dip of the side veins is about 78° to the south; course nearly east and west. We have six locations covering the different veins, five being 600 by 1,500 feet, and one being 300 by 1,500 feet.

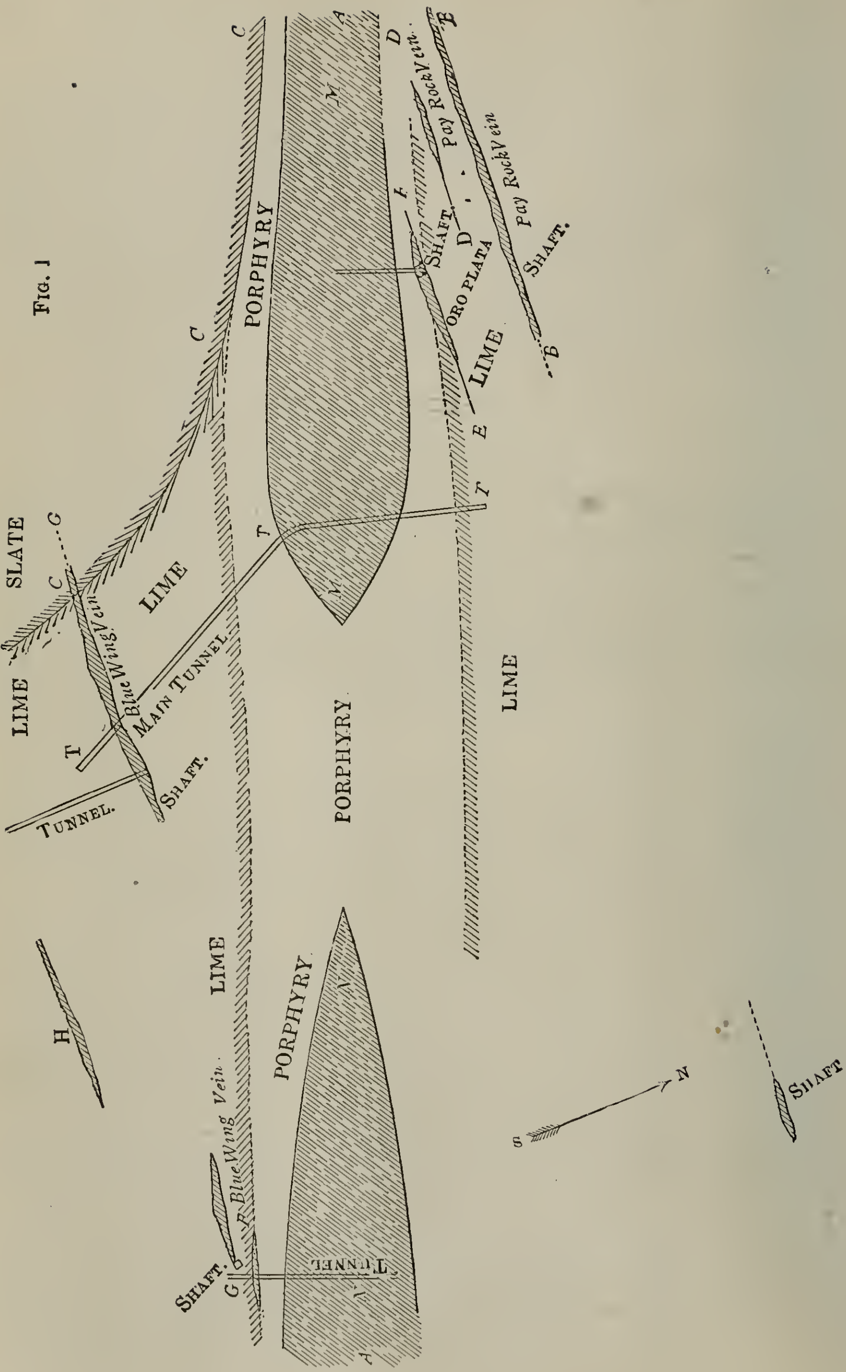
We have opened two shoots or bodies of ore on the main opening, one marked MM and the other NN. The length of either is not fully known, but in each case is probably about 1,000 feet. The width between walls varies up to 300 feet, with a maximum width of the ore bodies of 200 feet.

The ore body MM is opened by a tunnel, marked TT, 800 feet into the hill. This tunnel crosscuts the vein. The crosscut shows both walls, at this point, to be limestone. The opening between lime walls is 300 feet. In this opening is 200 feet of vein matter, with 50 feet of birdseye porphyry on either side of the vein between it and the lime walls.

From the point marked c', the vein, going westerly, follows the contact between the lime and the slate, the north wall being lime and the south wall slate, the contact and the vein cutting the formation at an angle of about 15°.

From the point marked c'—going easterly—the contact makes a bend towards the south. The vein, however, does not follow the contact, but continues its course, cutting across the limestone, both walls now being lime. The main vein here still cuts the formation at an angle of 15°, the side veins running into it being conformable with the apparent stratification.

Fig. 1


SLATE
LIME
PORPHYRY
LIME
PORPHYRY
LIME
PORPHYRY
LIME
LIME
Blue Wing Vein
Blue Wing Vein
MAIN TUNNEL
TUNNEL.
TUNNEL
SHAFT.
SHAFT.
SHAFT.
SHAFT.
SHAFT
ORO PLATA
Pay Rock Vein
Pay Rock Vein
H
N
S

The ore in all the veins is an exceedingly hard quartz, carrying gold, silver, and what is nominally gray copper, galena, and zinc blende. This ore has several interesting peculiarities. In the first place, it carries absolutely no iron pyrites—which are found in considerable quantities in every other gold-bearing vein in our section, outside of this particular belt of veins. Again, the gray copper—or what is nominally such—is shown by analysis to contain very little sulphur—which is largely, and, in some cases, almost entirely replaced by selenium. And besides copper, the mineral carries gold, silver, lead, zinc, bismuth, antimony, iron, and manganese.

Another peculiar feature of the main vein is this: In cross-cutting the vein in the tunnel TTT, the quartz for the first 150 feet carried free gold, and the sulphurets were nominally pure gray copper, no galena or zinc blende being found. The ore assayed ounce for ounce in silver and gold; and the loose gold in the clay seams was worth about $19 an ounce. For the last 50 feet the quartz carried little or no free gold. The sulphurets were galena and zinc blende, and the loose gold was very silvery—being worth only $14 an ounce. The sulphurets here assay from 6 to 8 ounces in silver to 1 of gold.

The same peculiarity is noticed in all the side veins; those on the south side of the main opening carrying free gold and gray copper, with no galena or zinc blende; while those on the north side carry little, and in some cases, no free gold, and no gray copper, but carry galena and zinc blende assaying high in silver.

In the main opening AA the vein-matter between the porphyry walls consists of strata of quartz and porphyry. For a depth of 300 feet, in some cases, from the surface, the vein is decomposed and disintegrated, so that it bears some resemblance to a gravel-bank, though the quartz is all sharp. This decomposition has broken up the quartz into pieces from many tons weight down to fine sand, and the porphyry in many places has been changed to clay.

Our method of working this vein is by an open cut from the surface, making a funnel-shaped hole, connected by a shoot with a tunnel below, through which all the material mined is run out. The sketch marked Fig. 2 shows the present appearance of the pit and of the arrangement of the tunnel.

The tunnel is run in from the surface, so as to partly cross-cut the formation. The grade of the tunnel is about 5 inches in 12 feet, and it is wide enough to allow a track, flume, water pipe, and air pipe to run all the way in. At the end of the tunnel, and under the pit, is a chamber 9 feet by 25, and 20 feet high in the clear. This chamber is connected with the workings above, by what is now a short shoot. At the bottom of this shoot is a large gate; below the gate is a grizzly and a platform and a small bin, for loading into a car. The flume which runs through the tunnel comes in under the grizzly, and the water pipe connects with a small tank at the head of the flume.

Our method of working, in detail, is as follows: In the open cut we run powder drifts, with TT, as in bank blasting. We run the drifts in about 15 feet from the face of the bank, and the TT from 15 to 20 feet on either side, usually taking a 15-foot face to the bank, on a stope up from the bottom. We load from 150 to 300 pounds of powder (low-grade powder) in each T, and fire by battery. One such shot will dislodge from 3,000 to 4,000 tons of material, which is thrown down to the bottom of the pit and into the shoot. It is then drawn from the shoot as fast as wanted, by means of the gate. As it comes through, it passes on to a grizzly, the

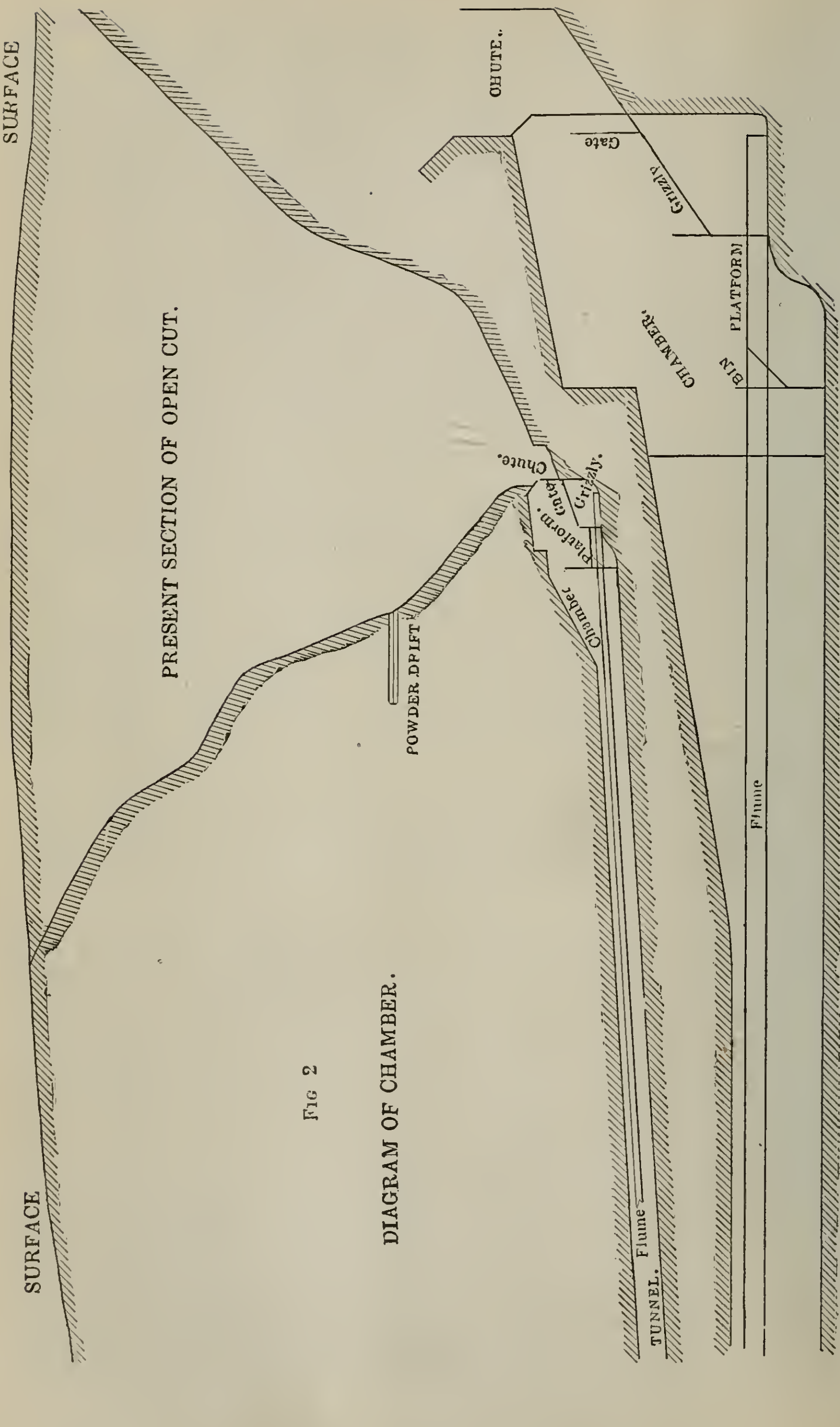


Fig 2

DIAGRAM OF CHAMBER.

bars of which are set 5 inches apart. The coarser material passes over the grizzly and on to the platform and bin below, from which it is loaded into cars and run out. What goes through the grizzly drops into a hopper below, from which it is fed into the flume.

This flume is 14 inches wide and 18 inches deep. It has a grade of 5 inches in 12 feet, and we run about 130 inches of water in it. This water carries all the material that comes into the flume out of the tunnel, and dumps it into a dump-box.

The dump-box is a large double compartment box, each compartment being 35 feet by 12, and 9 feet in the clear. It is provided with a large movable "tom-iron," and two hydraulic nozzles working under 90 feet pressure. The mine is worked on the day shift only, the quartz and dirt being run into one compartment of the box. The dump-box is run on the night shift, when the material that comes in by day is thoroughly washed free from clay, and is then run into another set of sluices, which convey the quartz direct to the mills.

At the mills the quartz-sand and dirty water are passed over a long grizzly of perforated screens. The quartz drops from this directly into the ore bins, and the sand and dirty water passes through the screens and is dropped into another flume. As the quartz goes into the mills it is also separated automatically as to size—the finer part going to the stamp mill, and the coarser to the concentrating mill. The waste water and sand that goes through the grizzlies is taken by the flume below to what is called the "plate house," where it is distributed over silvered plates.

We mine on week days only, running the mills every day. In every working day we mine about 300 tons of material. Of this about 10 per cent is run out in cars, and 90 per cent comes out in the flumes. This material is largely clay and sand, too fine to pay for further crushing. Three hundred tons of this dirt will produce 95 tons of milling quartz. This loose material—the sand and clay—all carries a considerable amount of fine loose gold, varying in size from the finer float gold up to particles the size of the head of a pin—we never find any coarser than this. This gold we save in the sluices and plate house. For this purpose we have the following arrangement of flumes, etc.: The flume from the chamber to the dump-box is 800 feet in length; grade, 5 inches in 12 feet; width, 14 inches, and is lined with block-riffles the entire way. The flume from the dump-box to mills is 300 feet long; grade, 6 inches in 12 feet; width, 24 inches, and is also lined with block-riffles. From the mills to the plate house the flume is 300 feet long; grade, 6 inches in 12 feet; width, 24 inches, and is lined with slat-riffles. These various flumes pick up about all the visible gold, so that the material that goes into the plate house is apparently nothing but sand and dirty water.

In the plate house this sand and water is divided into 6 equal parts, dropped into distributing boxes, and run over 6 aprons. These aprons are 20 feet long by 9 feet wide, with a grade of 5 inches in the 20 feet of length. Near the lower end each apron is covered with an apron of silvered plates, 9 feet square; below the silvered plates is a riffle filled with mercury, to catch loose amalgam, and below the aprons is a tank into which everything drops, to catch the loose mercury. All the water and sand is run over these aprons, each carrying about 20 inches of water. These aprons save the float gold that has escaped the sluices, and sometimes give astonishing results. We have cleaned up as high as 160 ounces of amalgam from them in a week. This gold is of the finest possible sort, and the amalgam has absolutely no grit, and is apparently almost a homogeneous

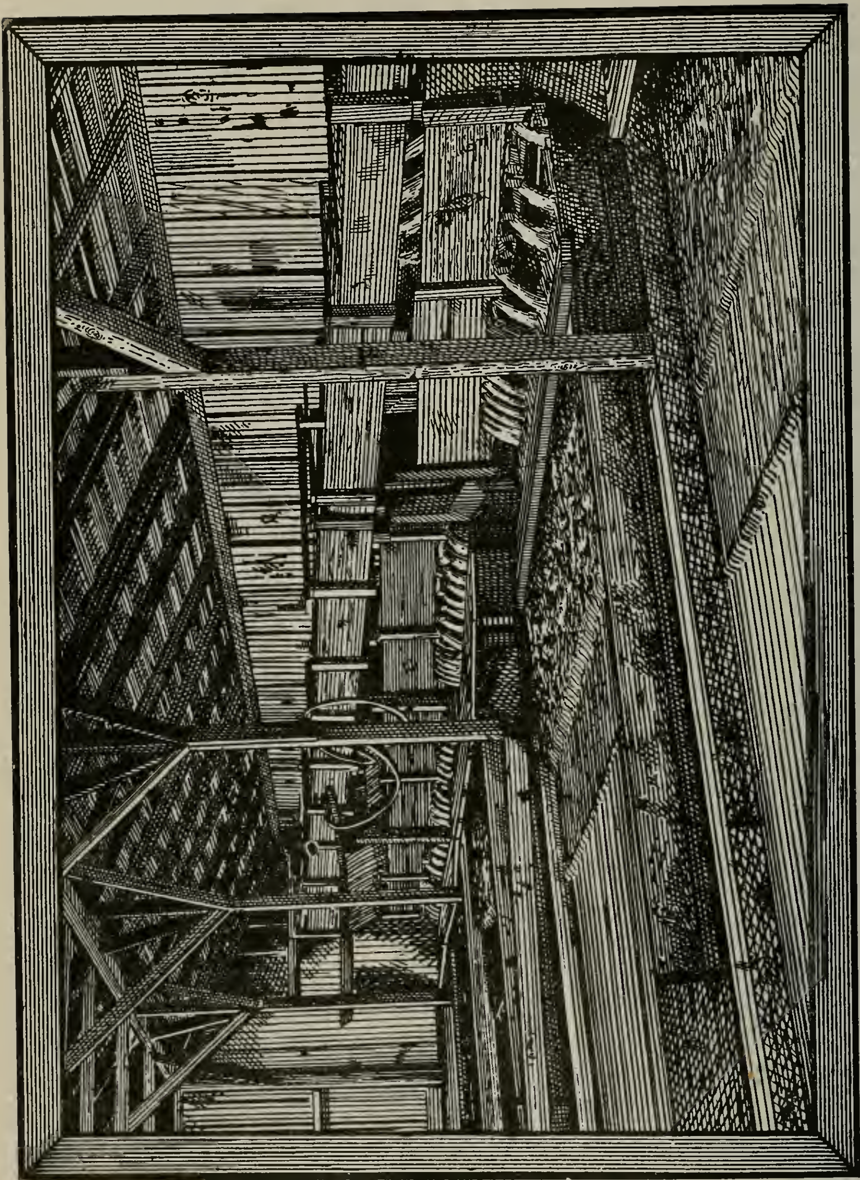


Plate House, Willard Mine.

mass of hardened mercury. The water, after leaving these plates, goes to waste, the plate house being the last gold-saving apparatus we employ.

At present we are working only the main vein. A great amount of work, however, has been done on the side veins, and a number of promising bodies of high grade ore have been developed. These side-vein ore bodies vary in length from 70 to 500 feet or more; the veins average in thickness

from 2 feet to 8 feet, and the walls are hard and firm. A large amount of ore has been taken from them near the surface and worked, and we are now preparing to open and work them at a depth.

We are running two mills—a stamp mill and a concentrating mill. The stamp mill is an ordinary mill of that sort. It contains 15 stamps, in 3 batteries of 5 each, with self-feeders, ore bins, and plates. We work all the fine part of the quartz here, so no rock breaker is required; and as the fine quartz carries little or no mineral, we have no concentrators here.

The stamps weigh 750 pounds each, work under a 6-inch to 8-inch drop, and drop 96 times a minute. We crush through a No. 5 slot screen, and crush $2\frac{6}{10}$ tons to the stamp in 24 hours.

We amalgamate entirely outside. For this purpose we have silver-plated aprons below the mortars, each apron being 4 feet 4 inches wide and 12 feet 6 inches long, with a grade of $1\frac{3}{8}$ inches to the foot. Below the aprons we have 12 feet of spout plates to each apron, 18 inches wide by 12 feet long, grade $\frac{3}{4}$ of an inch to the foot. The free gold in our rock, especially in the finer rock, is very fine flour gold. It is worth $18 50 an ounce, yet an ounce of dry, hard amalgam will only retort about one fifth gold. We have experimented with crushing through every size screen from No. 9 down to No. 4, and we find that although our gold is so very fine, yet we save the most per ton in crushing coarse through a No. 5 screen, and at the same time have a largely increased capacity over a fine screen.

The coarse rock and all the sulphur-bearing rock goes to the concentrating mill. This mill is constructed on a different principle from most mills of the sort, as we use Tustin pulverizers instead of stamps for crushing the quartz. The ore first goes through a 12-inch Blake rock breaker and then drops into the ore bin, from which it is fed to the Tustin pulverizers. These pulverizers are provided with automatic self-feeders, the same as we use in the stamp mill, and they feed the same way. We crush wet and amalgamate on aprons, after which the pulp is concentrated on Frue vanners.

We run four pulverizers. These run at 20 revolutions a minute, requiring 4-horse power each. We crush through a 20-mesh steel wire screen, the capacity of each machine being from 10 to 11 tons a day on the kind of rock that comes to it. The aprons are silvered plates, 4 feet wide by 10 feet long; grade, $1\frac{3}{8}$ inches to the foot. We use 8 Frue vanners, 2 to each pulverizer. Our coarse rock carries a very small per cent of sulphurets, from $\frac{1}{16}$ to $\frac{1}{4}$ of 1 per cent. The sulphurets, however, are very high grade, some being worth, when pure, upwards of $5,000 a ton. We concentrate our rock up to from 82 to 88 per cent of the assay value, according to the kind and grade of the rock.

A comparison of the two methods of crushing shows a marked difference in results. In crushing through the battery a large amount of slimes are produced. With the pulverizer a very small quantity of slimes is made. As a consequence, with our ore, where the rock is very hard, the gold exceedingly fine, and the sulphurets soft and brittle, we find that on the same ore we amalgamate a much greater percentage of the fine gold after the pulverizers than after the stamps; and when we come to concentrate, we can save only 18 to 20 per cent of the assay value of the ore after stamps, and 85 per cent after the pulverizers. On the same ore and with same screen our pulverizer is about the equivalent of 6 to 8 stamps, according to the character of the ore.

Our sulphurets we work ourselves, by roasting and chlorination. Our roasting works consist of two "Willard" furnaces, with all necessary appurtenances. These furnaces are of a ton capacity each to the charge, and

we can roast, if necessary, from 6 to 8 tons a day. The chlorination works are of equal capacity, consisting of 11 pairs of leaching and settling tanks, with generators, etc. We roast the sulphurets, granulate them, and run them in a car to the chlorination works. After which, they are treated in the usual manner, and the gold leached and precipitated.

We run entirely by water power. We use 130 inches in the mine. In the stamp mill we use, for power and amalgamating, 80 inches, under 140-foot head. In the concentrating mill we use, for power, amalgamating, and concentrating, 100 inches, under 160-foot head.

The cost of mining is about 50 cents per ton of quartz, delivered at mill. The average cost of milling in the two mills is about 60 cents a ton.

We employ 12 men altogether about the mine, including men in the open cut at the chamber and dump-box, and car men. In the mills we employ 7 men, and at the chlorination works 2 men, making a total of 21 men, on an average.

We have done no development work the past year, but are now putting up compressor, etc., for power drills, and propose soon to open up various veins at a depth.

Altitude, feet	2,200
Number of stamps	15
Weight of stamp, in pounds	750
Drop of stamps, in inches	6–8
Drop of stamps, per minute	96
Duty of stamp in 24 hours, tons crushed	$2\frac{6}{10}$
Size of screens, Slot No.	5
Number of Tustin mills	4
Revolution of Tustin mill, per minute	20
Duty of Tustin in 24 hours, tons crushed	10–11
Size of screen in Tustin, mesh	20
Miner's inches of water used in 24 hours in stamp mill	80
Miner's inches of water used in 24 hours in Tustin mills	100
Miner's inches of water used in 24 hours in mine	130
Pressure of water in stamp mill, in feet	140
Pressure of water in Tustin mill, in feet	160
Cost of mining, per ton	50 cents.
Cost of milling, per ton	60 cents.
Number of concentrators	8
Percentage of sulphurets	$\frac{1}{8}$
Number of men in mine	12
Number of men in mill	7
Total number of men employed	21

EL DORADO COUNTY.

The county is bounded on the north by Placer; on the east by Alpine County and the State of Nevada; on the south by Amador and Alpine Counties; and on the west by Placer and Sacramento. Geologically it differs but little from Amador, Calaveras, Tuolumne, and Mariposa Counties. The belts of limestone and granite and volcanic flows, form about the same prominent features within its boundaries as they do in the counties to the south through which passes the great auriferous lode. The county is celebrated for having sent forth to the world the first authentication of gold having been found in the State. Latterly renewed activity has been displayed in developing the mineral resources of the county, consequently many rich finds have been recorded.

SPRINGFIELD MINE.

This mine, formerly known as the Church Union, is the representative mine of the county; is situated at an altitude of 1,200 feet above sea level. The dimension of the claim is 4,500 feet on the lode; course of the vein is north and south; the dip about 80° to the east, and the average width about 3 feet. On the property is a 15-stamp water-power mill, using 110 inches of water, under a pressure of 450 feet, every 24 hours. Each stamp weighs 600 pounds, falls 9 inches, at the rate of 90 times per minute, and crushes $1\frac{3}{4}$ tons of ore per diem. The ore, free milling, containing about one per cent of sulphurets, is worked after the usual method of amalgamation in batteries and collection on outside plates. The sulphurets, after collection on Frue vanners, are worked by the chlorination process at the company's works, at a cost of $10 per ton.

Altitude, feet	1,200
Number of stamps	15
Weight of stamp, pounds	600
Drop of stamps, in inches	9
Drop of stamps, per minute	90
Duty of stamp in 24 hours, tons crushed	$1\frac{3}{4}$
Miner's inches of water used in 24 hours	110
Pressure of water, in feet	450
Number of concentrators	3
Percentage of sulphurets	1
Value of sulphurets, per ton	$150 00
Cost, per ton, of working sulphurets	$10 00
Length of ore-shoot, in feet	800
Depth of shaft, in feet	1,400
Average width of vein, in feet	3

STUCKSLAGER QUARTZ MINE.

This mine, formerly known as the Sam. Sims, in Coloma Mining District, is noted as the first place in which the mineral roscoelite was found, and is worked solely as a pocket mine. A shaft has been sunk on an incline of 45° to connect with a tunnel 300 feet long. The claim is 1,500 feet long by 600 feet wide, and carries a five-foot vein; the hanging-wall is syenite, and the foot-wall is slate. The method of reduction and recovery is in the hand mortar and an arastra run by horse-power. The property was located in 1868, and from that date to the present time there have been several successive owners, all of whom have retired well recompensed.

FRESNO COUNTY.

ABBEY MINE.

This mine, owned by G. W. Grayson & Co., is situated in Fine Gold Mining District, in a formation of granite, at an altitude of 1,700 feet above the sea. The vein is about two feet in width; has an east and west course, and dips 22° to the north. The mine is worked through a shaft, which, on the incline, is 1,500 feet—reaching a perpendicular depth in the mine of 300 feet. The formation of the hanging-wall is granite, and of the foot-wall, syenite. The developments are three tunnels 200, 300, and 400 feet, respectively; a shaft 500 feet in depth, from which tunnels are run from the various levels on the vein, the longer of which is 300 feet easterly and 125 feet westerly on the vein.

The 10-stamp mill, hoisting works, and pumps are run by steam power. 80 per cent of the yield is obtained from the batteries, and 20 per cent from the outside plates. The plates are 4 feet in width, and 12 feet in length to each battery, inclining 1¼ inches to the foot.

Altitude, feet	1,700
Number of stamps	10
Drop of stamps, in inches	5
Weight of stamp, in pounds	800
Drop of stamps, per minute	96
Duty of stamp in 24 hours, tons crushed	2
Size of screens, slot	9
Depth of shaft on incline, in feet	1,500
Vertical depth, reach by shaft, in feet	300
Length of ore-shoot, as far as explored, in feet	500
Average width of vein, in feet	2
Cost of mining, per ton	$3 00
Cost of milling, per ton	$2 00
Percentage of recovery saved in batteries	80
Percentage of recovery collected on plates	20
Number of concentrators	4
Percentage of sulphurets	2½
Value of sulphurets, per ton	$225 00
Number of men in mine	30
Number of men in mill	5
Extra help about mine	15

NEVADA COUNTY.

This county, reputed to be the first in the State where quartz ledges were mined for gold, holds at the present time its prestige as one of the largest producers of the precious metal. The county is bounded on the north by Yuba and Sierra, on the south by Placer, and west by Yuba Counties, and on the east by the State of Nevada. The auriferous belt varies greatly in different sections of the county; some of the mines are in slates, some in granite, and others on the contact between granite and slate, the formation being granitoid rocks and metamorphic slates.

THE NORTH STAR MINE,

In Grass Valley Mining District, which lay idle for ten years, has been resuscitated, and is now in full operation; the owners have just incurred an expense of $80,000 for laying a pipe line, 20 inches in diameter, a distance of 2 miles, and a 40-stamp mill with all the latest attachments. The pipe will cross Wolf Creek, making considerable descent and ascent, and from the head of source to the point of discharge, will have a 250-foot fall. The capacity of the mill used at the present time is 20 stamps, and is run by water power; each stamp weighs 850 pounds, falls 7 inches at the rate of 90 times per minute, and crushes 2 tons of ore every 24 hours. The ore is that generally termed free milling, contains from 2 to 3 per cent of sulphurets composed of iron and copper pyrites, mispickel, galena, and zincblende. The sulphurets, having an assay value of $100 per ton, are saved by the Triumph concentrator and are treated by the chlorination process at a cost of $20 per ton. 80 per cent of the gold yield is recovered in the batteries and 15 per cent collected on the outside plates. The altitude is 2,400 feet above sea level, and the course of the vein is northwest and southeast, with a northerly dip of 26°.

Altitude, feet	2,400
Number of stamps	20
Weight of stamp, pounds	850
Drop of stamps, in inches	7
Drop of stamps, per minute	90
Duty of stamp in 24 hours, tons crushed	2
Percentage of recovery saved in batteries	80
Percentage of recovery saved on plates	20
Percentage of sulphurets	2–3
Value of sulphurets, per ton	$100 00
Cost, per ton, of working sulphurets	$20 00
Number of men in mine	150
Number of men in mill	——
Depth of shaft on incline, feet	1,500
Length of ore-shoot, feet	1,800
Average width of vein, feet	2
Number of concentrators	8
Cost of mining, per ton	$3 00
Cost of milling, per ton	$3 00

THE IDAHO MINE.

The Idaho Quartz Mine, in Grass Valley Mining District, paid, on the first Monday in August, its 202d monthly dividend. The first work done on the mine was a prospecting shaft, sunk on the south side of Wolf Creek, in 1864. No further developments were made until 1865, when the shaft was continued to a depth of 300 feet, from whence a drift to the westward opened into pay ore. The first dividend was paid in 1869, and, with but few exceptions, there have since been regular monthly payments. The yield of the mine, up to the present time, has been about $8,000,000, and the net profits, in dividends, to the owners, about $3,750,000. The shaft, reaching the 16th level, has a length of 2,200 feet on the incline, which is, vertically, a depth of 1,600 feet from the surface, and is being continued to reach a perpendicular depth of 1,700 feet. The ore-shoot—there being but one in the mine—is 1,200 feet in length, bearing to the eastward; in fact, all levels below the 7th have been run in that direction.

The claim is 3,100 feet, lineal, on the lode; course of the vein is north of east and south of west, dipping southerly about 65°; both foot and hanging-walls are classified as magnesian metamorphic rocks. There is a 35-stamp water-power mill on the property, each stamp having a weight of 850 pounds, falling 9 inches, dropping 72 times per minute, and crushing 2.85 tons of quartz every 24 hours. The ore is wet crushed, and when issuing from the batteries is conducted over blankets. The lighter particles are carried off by the force of the current, and the blanket savings are worked in the Attwood amalgamators, in which most of the gold is recovered. The skimmings are ground in the Knox pans. It is necessary that the blankets should be frequently washed; therefore, at intervals, the flow of the water and sand is turned from channel to channel, as the case requires, and the blanket over which the current no longer flows is taken up, and the savings washed into the tank preparatory to being fed to the amalgamator. The blanket is again relaid, the water and crushings are turned upon it, and the cleansing treatment is carried in a similar manner to the next blanket channel. Any gold that may escape the blankets is saved on the sluice plates, although the percentage so collected is not known. There is no amalgamation done in the batteries, nor any separate record kept of percentage saved by the different methods of recovery. The sulphurets, iron pyrites, and galena, $80 in value per ton are saved by the Cornish buddle and rocker, and are worked by the chlorination process at a cost of $20 per ton.

At the 1,000-foot level there are two 35 horse-power engines, run by com-

pressed air, which hoist the ore to the station, whence it is raised by water power to the surface. Formerly steam was the motive power, but since it has been substituted by water, the company saves an average of $30,000 per year.

Altitude, feet	2,500
Number of stamps	35
Weight of stamp, pounds	850
Drop of stamps, in inches	9
Drop of stamps, per minute	72
Duty of stamp in 24 hours, tons crushed	285
Size of screens, slot	5
Percentage of sulphurets	½
Value of sulphurets, per ton	$80 00
Cost per ton of working sulphurets	$20 00
Number of pans	4
Cost of mining and milling, per ton	$7 65
Number of men in mine	173
Number of men in mill	18
Number of men in and about mine	218
Vertical depth reached by shaft, about, in feet	1,700
Length of ore-shoot, feet	1,200
Average width of vein, feet	2½

THE EMPIRE MINE

Is in Grass Valley Mining District, about three fourths of a mile southeasterly from the Town of Grass Valley, and is one of the largest producers in the county. The dimension of the claim is 5,000 feet in length and 750 feet in width, being a consolidation of several mines. The altitude is 2,800 feet; course of the vein is north and south, with a westerly dip of 35°. The mill, of 40 stamps capacity, is run by water power; the stamps, weighing 850 pounds each, fall about 7 inches, at the rate of 95 times per minute, and crush 2 tons of ore every 24 hours. The number of miner's inches of water used is 80 inches in the mill, and 150 for hoisting works, pumps, and compressor. The water has a fall of 440 feet. So far there has been no adoption of style or size of screens, but a series of experiments are being conducted for the purpose of selecting the most suitable.

The developments made during the year comprise a shaft 150 feet deep and about 1,000 feet of drifts.

Of the yield of free gold, 80 per cent is saved in the batteries and 20 per cent is collected on the outside plates.

The sulphurets, iron pyrites containing a small amount of galena, varying in value from $120 to $300 per ton, are saved from the sluice tailings by the Triumph concentrator, of which there are 16 in the mill. The gold is extracted therefrom at a cost of $20 per ton, at custom works, by the chlorination process. The hanging-wall is diabase, but the formation of the foot-wall is as yet undetermined.

Altitude, feet	2,800
Number of stamps	40
Weight of stamp, pounds	850
Drop of stamps, in inches	7
Drop of stamps, per minute	95
Duty of stamp in 24 hours, tons crushed	2
Size of screens	Experimenting.
Miner's inches of water used in mill in 24 hours	80
Miner's inches of water used in hoisting works in 24 hours Miner's inches of water used in pump Miner's inches of water used in compressor	150
Pressure of water, in feet	440
Cost of mining, per ton	$3 00
Cost of milling, per ton	$0 75
Percentage of recovery saved in batteries	80

Percentage of recovery saved on plates	20
Number of concentrators	16
Percentage of sulphurets	2
Value of sulphurets, per ton	$120 00–300 00
Cost of working sulphurets, per ton	$20 00
Number of men in mine	150
Number of men in mill	8
Length of ore-shoot, feet, said to be	4,000
Average width of vein, feet	$2\frac{1}{2}$
Length of longest incline shaft, feet	1,600
Vertical depth reached by incline shaft, feet	600

PROVIDENCE MINE.

The mine is located on Deer Creek, $1\frac{1}{4}$ miles west of Nevada City, in Nevada City Mining District, at an altitude of 2,500 feet above sea level, in granite, contact and slate formation. Within the boundary lines of the patent are two distinct ledges running parallel to each other, each ledge averaging four feet in width. The veins have a north and south course, with an easterly dip.

In the Providence proper the shoots of ore throughout the mine vary in length from 50 feet to 400 feet, while in the Ural, or parallel ledges, the stopes are continuous, and average 250 feet in length. The Providence is opened, by one incline shaft, to a depth of 1,100 feet; the formation for 900 feet is granite, thence 900 feet of contact, followed by 1,800 feet of slate; both hanging and foot-walls change from granite to slate. There are eleven tunnels or drifts in the mine, the longest of which is 3,600 feet; in the latter the hanging-wall for the first 2,000 feet is granite; then giving way to slate, which continues the remainder of the distance; in the foot-wall the slate begins after 840 feet of granite.

The Ural vein is worked through a crosscut, 547 feet in length, run in a westerly direction, at the 600-foot level, in the foot-wall of the Providence mine. At the point where the crosscut intersected the Ural the vein is a contact, and so continues for a distance of 40 feet south, where both hanging and foot-walls become slate. The average width of the vein is 4 feet. A tunnel on the course of the ledge 584 feet in length is in quartz nearly the whole distance.

The following diagram will show the positions occupied by the Providence, Ural, and Wyoming Lodes. It will be seen that the Providence Lode and crosscut No. 1 are in granite; also, that the Ural Lode leaves the contact and runs into slate; also, a cross ledge running from the Ural into the Wyoming Lode.

The Providence Lode ran into slate on the 600-foot level, at a point 800 feet south of the incline shaft, and then became a contact vein.

Mr. Joseph Thomas, underground Superintendent of the Providence Mine, has for years, contrary to the opinions of many other persons, asserted that within the boundary lines of the company's property, to the west of the vein being worked, there existed a parallel ledge. Since he has proven the correctness of his opinion, he says that the Ural and Wyoming Lodes are parts of one and the same fissure, but that the former is lying on a big horse, and the cross ledge is running from the Ural to the Wyoming, and in going south the two will come together and form one lode.

The property has an area of 145 acres, and is in length 6,000 feet. The wet crushing 40-stamp mill uses 80 miner's inches of water every 24 hours; for pumping and hoisting 45 miner's inches are necessary, under a pressure of 380 feet. The stamps weigh 750 pounds each, fall from 6 to 8 inches, drop 93 times per minute, and crush, to the stamp, 2 tons of

Cost of mining, per ton	$3 50
Cost of milling, per ton	$1 00
Percentage of recovery saved in batteries	40
Percentage of recovery saved on plates	60
Value of sulphurets, per ton	Not stated.
Percentage of sulphurets	$2\frac{3}{4}$
Number of concentrators	8
Number of men in mine	30
Number of men in mill	5
Number of men otherwise engaged	5
Depth of shaft on incline, feet	900
Length of tunnel, feet	3,000

NEVADA CITY GOLD QUARTZ MINE.

Is in Nevada City Mining District, about one mile west of Nevada City, and at an altitude of 2,500 feet above sea level. The course of the vein is northerly and southerly—20° to 30° west of north and 20° to 30° east of south, dipping 33° to the east—the hanging-wall being granite and the foot-wall slate. The claim covers an area of 40 acres, and is 2,500 feet lineal on the vein. The mine is worked through two incline shafts 850 and 530 feet respectively, and is opened up by 8,000 feet of tunnels or levels. From the 850-foot incline, tunnels have been driven south, averaging in length 250 feet each, on the 1, 2, 3, 4, 5, 6, and 7th levels, and are connected with each other by stopes and upraises. On the same levels north tunnels, connected by upraises and stopes, aggregating 6,000 feet, have also been driven. At the 350-foot level there is a drain tunnel 1,600 feet in length, connecting with the 530-foot incline—at the depth of 300 feet on this incline there is a level run connecting with the stopes from the 850-foot incline.

All of the machinery is run by water-power, the water being conveyed to the property through an eleven-inch iron pipe, 3,200 feet in length, under a 300 foot pressure, at a cost of 16 cents for a miner's inch for 24 hours' use. Although the mill, of 20 stamps, is run by water-power, there is a steam-power plant in place to be used in case of an accident to the waterworks. At the mouth of each incline are hoisting and pumping plants which may be run by water or steam as circumstances require. The stamps weigh 750 pounds each, fall from 7 to 9 inches at the rate of 93 times per minute, and crush about $1\frac{3}{4}$ tons of ore every 24 hours. Apron and sluice plates are silver-plated, the former being in size 4 by 5 feet, and the latter with an inclination of $1\frac{3}{4}$ inches to the foot, are 14 inches wide by a length of 12 feet to the battery. There is no separate account kept of the difference between the battery and plate savings, but merely a record kept of the general clean-up. The sulphurets, iron pyrites with an admixture of sulphides of arsenic, zinc, and lead, in value about $100 per ton, are saved by the Frue vanner, and worked by the chlorination process at a cost of $20. The developments during the year consist of drifting and crosscutting from the 850-foot incline, on 500, 600, and 700-foot levels, and opening up shoots, and the sinking of an incline 530 feet to the ore body.

Altitude, feet	2,500
Number of stamps	20
Weight of stamp, pounds	750
Drop of stamps, in inches	7–9
Drop of stamps, per minute	93
Duty of stamp in 24 hours, tons crushed	$1\frac{3}{4}$
Size of screens, round punched	5
Miner's inches of water used for all purposes, per diem	105
Pressure of water, in feet	300

Cost of mining, per ton	$2 50
Cost of milling, per ton	$1 00
Percentage of recovery saved in batteries	No record.
Percentage of recovery saved on plates	No record.
Value of sulphurets, per ton	$100 00
Cost per ton of working sulphurets	$20 00
Percentage of sulphurets	2–3
Number of concentrators	8
Number of men in mine, 25; boys, 7—total	32
Number of men in mill	6
Number of men in and about mine—all told	40
Length of ore-shoots, several, averaging in feet from	100–250
Average width of vein, feet	3
Depth of No. 1 shaft on incline, feet	850
Depth of No. 2 shaft on incline, feet	530

DELHI MINE.

(Contributed by E. H. Garthwaite, E.M.)

The mine is in Columbia Hill Mining District, near the town of San Juan, and has an altitude of 2,700 feet above sea level. The formation is metamorphic slate; the country rock is traversed by numerous dykes of diabasic rock. The course of the vein is north and south, with an easterly dip of 75°. Dimension of the claim is 1,500 feet in length by 600 feet in breadth. The improvements are an 8-stamp mill, wet crushing, and run by water power. Each stamp weighs 1,000 pounds, falls 6 inches at the rate of 94 times per minute, and crushes 3½ tons per diem. The plates are 46 inches wide, 36 feet long, and have an inclination of 80°. The formation of both hanging and foot-wall is slate. The nature of the sulphurets are iron, copper, and arsenical, and have a value of from $80 to $100 per ton, and are saved by the Triumph concentrator, but as yet they have not been worked. Every 24 hours there are 30 inches of water used, with a pressure of 200 feet. Shortly after the pay streak was struck in the main tunnel, another adit was started about 200 feet lower down the hillside. At the point where the adit was started there is no outcrop of the ledge, and by a miscalculation the starting point was in the hanging-wall. The error was increased by making the tunnel bear gradually to the east, instead of toward the west, so that when the tunnel had been advanced some 500 feet, the face was quite a distance in the hanging-wall from the ledge. Then the direction of the tunnel was changed; it bore westerly, and about 900 feet from the mouth cut the ledge, which was about 2½ feet wide and quite rich. The mine is very advantageously situated for deep exploitation, being located on the south side of the Middle Yuba, where the mountains are very precipitous, and the ledge can be opened up to a depth of at least 800 feet below its upper outcroppings by means of adit levels.

Altitude, feet	2,700
Number of stamps	8
Weight of stamp, pounds	1,000
Drop of stamps, in inches	6
Drop of stamps, per minute	94
Duty of stamp in 24 hours, tons crushed	3½
Size of screens, punched	5
Miner's inches of water used in 24 hours	30
Pressure of water, feet	200
Cost of mining, per ton	$2 00
Cost of milling, per ton	$0 60
Percentage of recovery saved in batteries	33–40
Percentage of recovery saved in plates	66
Number of concentrators	4
Percentage of sulphurets	½–3

Value of sulphurets, per ton	$80 00–100 00
Number of men in mine	8
Number of men in mill	3
Width of vein varies in feet from	3–18
Length of upper tunnel, feet	1,200
Length of lower tunnel, feet	600
Length of ore-shoot, feet	200

EAGLE BIRD MINE.

This mine is situated in Washington District, at an altitude of 3,700 feet above sea level, in slate and granite formation. The vein has a northerly and southerly course, dipping 67° to the eastward. The formation of the hanging-wall is slate, and that of the foot-wall is granite. The improvements on the property are, one 20-stamp mill run by water power, Blake crusher, air compressor, and hoisting works. The stamps weigh 750 pounds each, fall from 6 to 7 inches, and drop 95 times per minute, with a crushing capacity of 1½ tons of ore to the stamp every 24 hours. The plates, silver plated, have an inclination of 1¾ inches to the foot, are 4 feet wide, and 20 feet in length to each battery. Of the free-gold yield, the percentage saved in the batteries and collected on the outside plates is about equal. The dimension of the claim is 600 feet in width by 1,500 feet in length. Work was first commenced on the property by the sinking of a 400-foot shaft in 1873, since which time there have been five drifts run of 400, 250, 550, 350, and 175 feet in length, respectively.

Altitude, feet	3,700
Number of stamps	20
Weight of stamp, pounds	750
Drop of stamps, in inches	6–7
Drop of stamps, per minute	95
Duty of stamp in 24 hours, tons crushed	1½
Screens, brass wire, mesh	40
Miner's inches of water used in 24 hours	150
Pressure of water, in feet	175
Cost of mining, per ton	$2 50
Cost of milling, per ton	$0 55
Percentage of recovery saved in batteries	50
Percentage of recovery saved on plates	50
Percentage of sulphurets	¾–1
Value of sulphurets, per ton	$100 00
Average width of vein, feet	9
Depth of shaft, feet	400
Number of men in mine	24
Number of men in mill	5

SPANISH MINE,

Is a location about three miles north from the town of Washington, in Cherry Hill Mining District, and in altitude is 4,000 feet above sea level. The property consists of 11 claims, 600 feet by 1,500 feet each, course of the vein is north and south, dip 80° to the west, and both walls are slate inclosing a vein averaging 100 feet in width. The first work done on the claim was in April, 1885, but since then the following developments have been made: tunnel No. 1, 960 feet, tunnel No. 2, 100 feet; crosscuts, driven at intervals of about 200 feet, 860 feet; drifts on the ledge, 1,040 feet; prospect shafts, 5 in all, averaging 31 feet each; 3 upraises averaging 107 feet each. There are 4 Huntington mills, run by water power, at work on the ore, reducing in the aggregate 120 tons per day; two thirds of the gold yield is recovered by amalgamation in the mill, the remaining one third being collected on the outside plates. The plates, varying, are 4, 6, and 2 feet wide, with an inclination of 2 inches to the foot and 30 feet in

length to each mill. Water is the motive power, 55 miner's inches, under pressure of 250 feet, being used every 24 hours.

Altitude, feet	4,000
Number of mills, Huntington	4
Revolutions per minute	60
Duty of the mills in 24 hours, tons ground	120
Screens—homogenous steel, ¼ inch angle slot, No.	6
Miner's inches of water used in 24 hours	55
Pressure of water, in feet	250
Cost of mining, per ton	20 cents.
Cost of milling, per ton	40 cents.
Percentage of recovery saved in mill	75
Percentage of recovery saved on plates	25
Average width of vein, in feet	100
Number of men in mine, mining	5
Number of men in mine, prospecting	12
Number of men running mills	5
Length of No. 1 tunnel, in feet	960

SIERRA COUNTY,

One of the most rugged and mountainous counties in the State, is bounded on the north by Plumas, on the south by Nevada, and on the west by Yuba and Plumas Counties, the State of Nevada forming the eastern boundary.

The greater portion of the county is covered by eruptive conglomerates, underlying which are the auriferous slates, great masses of serpentine, and ancient gold-bearing gravel channels. As the greater part of the golden harvest of this county was recovered from the auriferous deposits of the ancient channels, the following interesting descriptions will be appropriate insertions:

The Great Blue Lead of Sierra County, by C. S. Capp, quoted in Hittell's "Handbook of Mining for the Pacific States." Mr. Capp writes:

This is not one of the many petty leads, an inch or two in breadth and thickness, which, after being traced a few hundred feet, end as suddenly and mysteriously as they commence; but it is, evidently, the bed of some ancient river. It is often hundreds of feet in width, and extends for miles and miles a thousand feet below the summits of high mountains, and entirely through them. Now it crops out where the deep channels of some of the rivers and ravines of the present day have cut it asunder; and, then, hidden beneath the rocks and strata above it, it only emerges again miles and miles away. Wherever its continuity has been destroyed, the river or gulch which has washed a portion of it away was found to be immensely rich for some distance below, and the materials of which the lead is composed are found with the gold in the bed of the stream. It is evidently the bed of some ancient stream, because it is walled in by steep banks of hard bedrock, precisely like the banks of rivers and ravines in which water now runs, and because it is composed of clay which is evidently a sedimentary deposit, and of pebbles and black and white quartz, which could only be rounded and polished as they are by the long continued action of swiftly running water. The bedrock in the bottom of this lead is worn into long, smooth channels, and also has its roughnesses and crevices like other river beds. The lighter and poorer qualities of gold are found nearer to its edges, while the heavier and finer portions have found their way to the deeper places, near the center. Trees and pieces of wood, more or less petrified and changed in their nature, which once floated in its waters, are also everywhere encountered throughout this stratum. The clay and finer gravel in which these pebbles and bowlders are found to be tightly packed, is of a light blue color, which gives the name to the lead. Much of this clay is remarkably fine and free from coarser particles, and is smooth and unctuous to the touch. It is said to be strongly impregnated with arsenic, as was shown by chemical analysis, and contains large quantities of iron and sulphur in solution, for pyrites and sulphurets of iron are deposited in shining metallic crystals in every vacant crevice. Fine gold is found among this clay, and the heavier particles beneath it, upon the bedrock. This stratum varies in thickness from eighteen inches to eight or ten feet, while the whole lead varies in width from a hundred and fifty to five hundred feet. The same lead has been found at Sebastopol, four miles above Monte Cristo, and also higher up among the mountains. It appears at Monte Cristo, which is four miles above the high-lying Downieville, and over three thousand feet above it, and at Chap-

arral Hill, on the side of a deep ravine; then, at the City of Six, which is also on very high land, about four miles from Downieville, across the North Yuba. It is next found at Forest City, on both sides of a creek, and is there traced directly through the mountain to Alleghany Town and Smith's Flat, on the opposite side. There it is again cut in twain by a deep ravine. It crops out on the other side at Chip's Flat, where it has been followed by tunnels passing completely through the mountain to Centerville and Minnesota on the other side. Here it is obliterated by the Middle Fork of the Yuba, but is believed to be again found at Snow Point, on the opposite side of the river; and again at Zion Hill, several miles beyond. There is no reason for doubting that after thus reaching over twenty miles, it still extends further. Hundreds of tunnels have been run in search of it. Where the line it follows was adhered to, they have always found it, and have been well rewarded for their labor. Millions of dollars have been taken from this lead, and its richness, even in portions longest worked, is yet undiminished. As in some of the claims quartz veins and poorer paying gravel have been found, many of them may be valuable to work from the top down, as hydraulic claims.

The theory that this blue lead was once the bed of an ancient stream, is generally accepted by those familiar with it. Another evidence to support the theory is, that in many places the flattish stones in the lead lie at a peculiar inclination, and all in the same direction, as stones do in a stream of water. This theory, however, does not find universal belief. Mr. B. P. Avery wrote thus of it for the San Juan *Press*, in 1859:

Everybody in California has heard or read of the famous "blue lead," which all miners who delve for gold far up in the mountains hope to find, and think themselves lucky when they have found it, and which they pronounce to be the channel of an ancient river. This lead is always found resting on or near the bedrock, beneath diluvial strata of different colors, such as shades of red, yellow, and gray, and is itself more of a deep slate color than blue. It is generally richer in auriferous particles than the gravel lying above it, and forms the productive drift diggings for which the vicinity of Forest City is noted, as well as those of many other localities. The theory of its origin alluded to above is predicated upon these facts and assumptions: that it has been traced in a continuous line, at a certain altitude, through several counties, from ridge to ridge, at a right angle to present watercourses, across cañons thousands of feet deep; that the stratification of the lead is uniform, and different from that of adjoining deposits; that tree trunks, both in the ligneous and petrified state, are found lying in it, as though borne there by freshets; and the gold found in it is everywhere of the same character as to appearance and quality. This crude theory conforms to the general one which is popularly employed to account for the extensive alluvial deposits constituting our placer diggings. It is remarkable that the majority of our miners, who are commonly men of intelligence and practical knowledge in their pursuit, should have discarded entirely, if they ever entertained, when speculating on the origin of our gold fields, the more rational theory of marine influence, for one of purely local causes. They overlook all the facts which go to prove a total submergence of this coast at some remote period, and settle down upon the narrow idea that the immense gravel beds which contain so large a portion of our mineral wealth, and which extend at least four hundred miles north and south, having an average breadth of probably not less than sixty miles, were deposited by rivers which anciently ran here, and changed their channels from time to time, until they paved the whole country with cobblestones. These deposits have been cut through by modern streams, running a different course, and hence the present cañons and ridges. Of the ancient rivers, the one that deposited the blue lead has alone left distinctive marks of its course. Now, unfortunately for the plausibility of this theory, the blue lead is found all the way from the summit of the Sierra Nevada to the foothills. Instead of being confined to a certain altitude, and a certain line, it exists in every altitude, on the main ridges as well as on spurs of them, and even on isolated peaks. Its color is owing to the presence of sulphuret of iron in solution, without which the gravel would not be any different from that lying above, except that the bowlders and large stones would be found in it, as they are always found at the bottom of every gravel deposit. Wherever sulphurous acid or sulphuret of iron is found, there the so called blue lead will be discovered, just as certainly as red earth and gravel will be found where the oxide of iron is present as a coloring agent. It is found at a great elevation in Sierra County, and at a low one in Nevada and Yuba. It has been struck at San Juan, and at points thirty or forty miles above it, leads of other colors intervening.

The "Dead Rivers of California," by John S. Hittell, quoted in "Raymond's American Mines and Mining." Mr. Hittell says:

A dead river is a channel formerly occupied by a running stream, but now filled up with earthy or rocky matter, and is not to be confounded with a channel that is open and remains dry during the greater part of the year because of a lack of water, or that has been abandoned by the stream for a deeper channel elsewhere. A dry river bed is *not* a dead river.

The dead rivers of California, so far as known, are on the western slopes of the Sierra Nevada, from 500 to 700 feet above the sea. They are all auriferous, and therefore they have been sought for and examined. They are not less interesting therefore to the miner than to the geologist; not less important to the statesman than to the antiquarian.

The largest dead river is known as "the Big Blue Lead," and has been traced from Little Grizzly, about latitude 39° 45′, in Sierra County, to Forest Hill, about latitude 38° 55′, in Placer County, a distance of 65 miles. The course is south-southeast, the position about 30 miles west of and parallel with the main divide of the Sierra Nevada. The elevation is 5,000 feet above the sea at Little Grizzly, and 2,800 at Forest Hill, showing an average fall of 33 feet per mile. The live rivers of the Sierra Nevada run at right angles to the course of the range, and have cut cañons from 1,500 to 3,000 feet deep, and they are separated by ridges which are from 3 to 6 miles apart, and are as high as the cañons are deep. The Blue Lead runs across these ridges from 200 to 1,000 feet below their summits. The traveler does not see any signs of a dead river in these ridges, which are as high and have the same general appearance at the Blue Lead as at other places. I shall presently tell how the miner discovers the lead, but before coming to that I want to give you a clear idea how the dead river crosses the ridges. Take a piece of common ruled cap paper; put your pen on a line, draw it up at an angle of 45° to the second line above, then down to first line at the same angle, and so on until the line made by your pen looks like eight rectangular saw-teeth, which are about an inch high. Consider those teeth as the ridges of the Sierra Nevada on the line of the Blue Lead in Sierra County, and the intervals between them as the cañons. Write over the first cañon to the left, Cañon Creek; over the next, Goodyear's Creek; and over the others consecutively, North Fork of the Yuba River, Rock Creek, Oregon Ravine, Wet Ravine, and Middle Yuba. Now draw a horizontal line across all the ridges a quarter of an inch from their tops. That line is the Blue Lead. The diagram, made as directed, represents a perpendicular section of the ridges and cañons of the Sierra Nevada, on the line of the Big Blue Lead in Sierra County, as seen from the west.

I have said that the traveler would see no sign of a dead river in riding over the country. The ridges are as high on its line as elsewhere; the cañon sides present the same appearance. Years elapsed before the miners discovered the existence of the ancient channel. But it required only a few months for the discovery that the live rivers were very rich in gold up to a certain point; that the abundance and size of the particles increased as they ascended up to that point; and that beyond or east of that point the streams were poor. Those points on the different streams were nearly in a line. Just there the ravines on the sides of the cañons were very rich, and they were comparatively poor elsewhere. The miners followed up the ravines, washing the dirt in their beds, and the dirt where the ravines were not too steep was a foot or two deep over the slate rock. At last, when the miners got near the top of the ridge, they found that the narrow shallow rock bed of the ravine suddenly disappeared, and the body of the hill was composed of gravel, which had a peculiar blue color, and part of it, a horizontal stratum about half a mile wide from east to west and five feet thick, was very rich in gold. They looked after the metal and paid little attention to anything else. As the stratum ran across the ridges from north to south, the miners followed it in with adits or tunnels, and in more than one place the tunnels met; and a few years ago it was customary for footmen passing between Monticello and Excelsior to go underground a distance of a mile rather than to climb over the hill six hundred feet high, by a path nearly two miles long. In the same manner Forest City and Alleghany were connected by a continuous tunnel; but the timbers have rotted, the roof has fallen in, and the passage is now closed.

The auriferous deposit is gravel, mixed with bowlders, clay, and sand, varying from a hundred to three hundred feet in depth; in strata distinguished from one another by differences in color, in the size of the bowlders and gravel, and in the number and size of the particles of gold. The predominant color is bluish-gray, dark at the bottom, and lighter above, with a reddish tinge in those places that have long been exposed to the air, showing the presence of iron. The material of the bowlders, gravel, and sand, is almost exclusively quartz. In the whole length of the river, as traced for a distance of sixty-five miles, assuming that the deposits of gravel average half a mile wide and two hundred feet deep, there were, counting in the portions which have been washed away by the live rivers, six billion six hundred and sixty million cubic yards of quartz and clay, and the quartz alone must have measured five billion cubic yards. In the live rivers quartz forms only a small portion of the gravel. Whence came all the quartz of the Big Blue? How did it happen that no granite, slate, porphyry, basalt, or sandstone was buried in this bed? If all the quartz veins now known in California were cleaned out to a depth of one hundred feet, they would not supply so much as is found in sixty-five miles of a river, that must have run for many hundreds of miles. The gravel is all water-worn, and rounded by long attrition. It came from far north. A piece of rough quartz, while being carried five hundred miles in the fiercest of our mountain streams, would not be worn so smooth as is every pebble in the Blue Lead. And the immense size of the bowlders implies a mighty current. Those in the lowest stratum average, in some places, a ton, and many are found of twenty tons. These are worn as smooth as the pebbles. They are not found scattered here and there, as though they had tumbled down from the banks of the river near to the spot where they are found; but they are evenly distributed in a stratum of equal thickness, across the whole bed, and for miles in length. Above that may be a stratum of bowlders of half the size, and then another stratum of larger ones. The great river handled these masses of rock with as much apparent ease, and spread them out as evenly, as if they had been no larger than pigeons' eggs.

The particles of gold are larger in size, and contain more silver at the bottom than at the top. The smaller pieces are in the upper strata, and as they have a larger surface proportionately, the silver is eaten out by the sulphurous acid which is developed in the gravel by the oxidation of pyrites. If a double eagle and twenty one-dollar pieces are thrown into a solution of vitriol, and left there for several weeks, the small pieces will, at the end of that time, contain a larger proportion of gold than the large one; and, for a similar reason, the surface placer gold is finer, chemically, than that obtained from the deeper strata. As a general rule the deep gold is 900 fine, or is worth $18 60 per ounce, and the surface gold is 920 fine, and is worth $19 per ounce, in the Big Blue Lead. The gold and gravel are deposited as in live rivers. There are banks, bars, eddies, ripples, rapids, and falls. There is little gold in the rapids and much in the eddies. The richest places have contained as much as fifty dollars to the cubic yard of the lower stratum; or, if the large bowlders were left out of the estimate, to two or three cubic feet. The space between the bowlders is filled with sand, clay, and gravel, which contains the gold. In the upper strata there are from fifty cents to two dollars to the cubic yard. The bed is of slate rock, and the banks are from fifty to three hundred feet high; but there are few places where they have been examined, for nowhere has all the gravel been washed away across the channel.

But how was it possible that the bed of a large river could be filled three hundred feet deep with gravel? When the miners in 1850, 1851, and 1852, flumed the live rivers of California, and took the gold from their beds, they found a deposit of gravel that did not average more than five feet deep on the bedrock, in streams that ran in cañons one thousand feet deep; and it is strange that the Big Blue should have filled its bed with gravel. Yet this filling up is not without an analogue in our day. Under the influence of hydraulic washing, Bear River and Yuba River have, within the last fifteen years, begun to fill up with gravel, and their beds have, for miles, risen seventy feet or more above the levels of 1853. This gravel is auriferous, and it is deposited in strata, and the arrangement and general appearance resemble those of the Big Blue Lead. The filling up began down in the valley, and as it ascended the current became less rapid, and lost the power to carry away the gravel. In Bear River, below Dutch Flat, the bed rises two feet per month during the chief washing season, from February to September, and in the remaining four months it falls on account of the stoppage of washing, and of the winter floods which carry away perhaps half of the accumulation of the summer. Some persons claim that various camps on parts of dead rivers in Plumas County are on the Big Blue Lead, and others think that portions of a dead river, near Placerville, belong to the same stream. I do not accept these theories, but if they are true, the Big Blue River has been traced about one hundred and ten miles. In the northern part of Plumas County the river is buried under deep beds of lava and basalt, and south of Placerville it is probably below the level of the live streams, and thus cannot be found by any system of mining or mode of prospecting now in use. Even in places where it is above the level of the live streams it may be covered on the sides of the cañons by slides of rock or of barren dirt or gravel, and the miner might spend thousands of dollars in a vain search for treasures not ten feet from his drift, as many have done, and some accident, luck, or perseverance afterwards proved the proximity of the rich deposit. In several cases the lead was found by calculation. The miner took his position on a hillside, on a line and on a level with other mining camps, and in a few days he found a fortune; and others have spent years working on a similar plan without success. The river must have taken bends on the north side of Rock Creek and Oregon Ravine, and twelve years of searching have not revealed the position of the bends. But why did the Big Blue River die, and leave nothing but its gravel and its gold to tell the story of its existence and of its greatness? The main cause must have been the subsequent rise of the Sierra Nevada. Suppose that a range of mountains, seven thousand feet high, were upheaved thirty miles east of the Mississippi; that the bed of that stream were on the mountain side three thousand feet above the sea, and that thirty miles west the country retained its present level; the result would be that the present Mississippi would soon be a dead river; it would be cut across by streams running down the mountain side, and pouring into a new Mississippi, thirty miles or more west of the present one. We know that the Sierra Nevada has been upheaved; that a large stream ran on what is now the mountain side, and that it has been succeeded by a new river farther west, and we must infer that the death of the old and the birth of the new river were caused by the upheaval.

Many of the hills crossed by the Big Blue are capped with lava and basalt, which covered much of the country from near the summit of the range to about three thousand feet above the sea. It seems then that the river filled its bed with gravel; the mountains began to rise, and volcanoes broke out along the divide; the lava ran down and covered the land to the line of the dead river and beyond it; the mountains rose still higher, and the waters running down their sides cut through the lava and made deep cañons, and washed away two thirds or three fourths of the dead river, and scattered its gold among the living waters. The descent of thirty-three feet per mile observed between Little Grizzly and Forest Hill would make a terrific current in a stream half a mile wide. The Sacramento is a lively river, yet its grade is only five feet in a mile. But no ordinary current could have carried the large quartz bowlders of the Big Blue Lead from distant regions and distributed them evenly over the river bed. It is possible, however, that in the lifting up of the mountains the relative elevations have been altered, and that the present grade differs from that of the Big Blue while it was alive.

A question suggests itself whether the great dead river was the predecessor of any live

stream; but to this no satisfactory answer can now be given, and it is doubtful whether time and research will ever furnish one. The Big Blue was parallel to the Sacramento, and has, to a certain extent, been succeeded by it; but it drained a much larger district than the Sacramento does, or the rainfall of the country was much greater in the era of its exisence. The Sacramento does not carry one fourth of the water which ran in the Big Blue—probably not one tenth. If we could ascertain that the quantity of rain had not altered, then we would be justified in presuming that the Columbia River, which would about fill the bed of the Big Blue, instead of turning westward at Walla Walla, originally continued southward, until the lifting up of Shasta and Lassen, and the adjacent ridges, stopped its course and compelled it to break through the Cascade Range at the Dalles. With our present limited knowledge we are not justified in calling the Big Blue River either the Dead Sacramento or the Dead Columbia.

Some persons have argued that the Big Blue Lead was never a river, but only a lacustrine or alluvial deposit. This theory, however, is untenable. The Big Blue Lead has all the marks which a dead river should have. It has a long course, a width nearly uniform, a course nearly straight, some bends with eddies on the inner side, a peculiar quartz, unlike any found in the neighboring ridges, or in the streams to the eastward, and abundance of quartz which no place now known to us could have supplied, and which came, probably, from a distant northern region, now covered with lava; water-worn gravel, which must have been carried far; flat stones, pointing down stream, as a current would place them; strata of coarse and fine gravel, which must have been deposited in a stream; a uniform descending grade: the coarse particles of gold, which could not have been distributed so evenly over a wide channel, except in a strong current; an immense quantity of gold, which required ages to scatter through a deposit three hundred feet deep; driftwood, unmistakably water-worn; trunks of trees, with the butts up stream; tributary brooks, and a number of other evidences, which would require more space for their description and explanation than I could spare. To say that the Big Blue is not a dead river is equivalent to saying that the bones of the mastodon never belonged to a living animal, but were formed under geological influences exclusively.

If this were the only dead river in the State, the proof would be less conclusive; but there are a dozen others. One, which runs southwestwardly, and may be called the Dead Brandy River, appears at La Porte, Brandy City, Camptonville, and North San Juan, and is marked by the same general characteristics, save that the gravel is finer, the pebbles in the upper strata being generally not larger than a pigeon's egg.

In Tuolumne and Calaveras Counties we have the Dead Stanislaus, or Tuolumne Table Mountain, which runs from near Silver Mountain, in Alpine, to Knight's Ferry, and there disappears. It is covered by a bed of basalt, which flowed as lava from a volcano and filled up the ancient bed; and this basalt has resisted the wear of the elements, and now stands as a mountain forty miles long, a quarter of a mile wide, and eight hundred feet high, the softer adjacent slate rock having been wasted and washed away. Under this mountain lies a dead river rich in gold. A similar table mountain of basalt, covering an auriferous dead river, which I call the Dead Cherokee, after its chief mining camp, extends seventy miles from Lassen's Peak to Oroville. At Bangor, in Butte County, is a small dead river, seventy feet below the general surface of the ground, and covered with ordinary soil and gravel. There are also dead rivers at Smartsville, Mokelumne Hill, and San Andreas. The Big Blue and the Dead Brandy are distinguished by the depth of their gravel and by the absence of pebbles of eruptive origin in it; and others have either short courses or shallow deposits of gravel; and the quartz forms a much smaller percentage of the gravel. In the dead rivers at Cherokee, Bangor, and Smartsville, a large proportion of the bowlders and pebbles is of lava and basalt, as if the streams had been formed after the commencement of the volcanic era. But different as is the material of the gravel, the fluvial origin of the deposits is similar and indubitable in all of them, when they are studied together.

SIERRA BUTTES MINE.

This property, in the Sierra City Mining District, is situated on the southern slope of the Sierra Buttes Mountain, whose peaks rise 4,700 feet above the lower works, and 8,800 feet above sea level. The altitude of the croppings is 6,400 feet, and that of the lower tunnel is 4,100 feet. The dimension of the claim is 11,000 feet in length by 600 feet in width; the vein has a general east and west direction, with a dip to the north of 41°, and averaging in width 20 feet. Work was first begun on the mine in 1850, and has been unremitting in dividends up to the present date. There are two water-power wet-crushing mills on the property, of 50 and 60 stamps, respectively; but only one, that of 60 stamps, is being used at present. The stamps weigh 850 pounds, fall 8 inches, strike 86 times per minute, and each stamp crushes 2⅓ tons of ore every 24 hours. The water supply, drawn from several lakes, is brought around the mountain-side, a distance of 7½ miles, in flumes to the mine. The main flume, 7

miles in length, is fed by several tributaries, which tap the sources of supply. The sulphurets are collected on the Frue vanner, and are treated at the company's works by the chlorination process. The property is now, and has been since 1870, owned and worked by an English company. The mine is worked through a series of nine tunnels.

Altitude of croppings, feet	6,400
Altitude of lower tunnel, No. 9, feet	4,100
Number of stamps working	60
Weight of stamp, in pounds	850
Drop of stamps, in inches	8
Drop of stamps, per minute	86
Duty of stamp in 24 hours, tons crushed	$2\frac{1}{3}$
Size of screens, slot	7
Width of apron plates, in feet	4
Width of sluice plates, in inches	15
Total length of plates, in feet	240
Number of concentrators	24
Miner's inches of water used	320
Pressure of water varies, in feet	60–620
Cost of mining, including dead work, per ton	\$3 98
Cost of milling, per ton	\$0 $37\frac{3}{4}$
Percentage of recovery saved in batteries	73
Percentage of recovery saved on plates	27
Percentage of sulphurets	$\frac{1}{2}$
Value of sulphurets, variable, per ton	\$90 00–550 00
Cost per ton of treating sulphurets	\$16 40
Average width of vein, in feet	20
Number of men in mine	210
Number of men in mill	10
Total number of men employed	290
Length of ore-shoots:	
Willoughby, feet	250
Tinney, feet	70
Bonanza, feet	210
Mammoth, feet	800
Length of No. 6 tunnel, in feet	4,850
Length of No. 7 tunnel, in feet	5,050
Length of No. 8 tunnel, in feet	5,200
Length of No. 9 tunnel, in feet	7,200

THE YOUNG AMERICA CONSOLIDATED MINING COMPANY.

The company's property is in Sierra City Mining District, about seven miles north of Sierra City, and has an altitude of 7,400 feet above the sea. The consolidation is 6,000 feet in length by 500 feet wide. The vein has an easterly and westerly course, a northerly dip of 45°, and averages $5\frac{1}{2}$ feet in width. The formation of the hanging-wall is diabase, the same in character as that which formed the hanging-wall of the rich auriferous shoot in the Eureka Mine at Grass Valley; also identical with the rocks forming the walls of the richest mines in Venezuela.

The mill occupies a site 3,200 feet from the mine—in this distance the perpendicular height of the mine above the mill is 900 feet. The ore is conveyed to the mill by an elevated tramway in buckets of 100 pounds capacity. At present it requires the work of two men to fill the buckets in transit, but that duty will soon be performed automatically by an invention of Mr. Busch, the foreman of the mine. The consolidation contains within its environs four lakes—the smaller one, three fourths of a mile below the mill, is used to impound the tailings; the higher one, directly under the snow-capped Buttes, feeds the waters of the melting snow to the reservoir, which furnishes the mill with power. The gross proceeds of the mine and mill, for the year ending August 15, 1886, amounted to \$294,000. For the first three months of the year there were but ten stamps, then ten more were added, making a crushing capacity of

20 stamps up to July 6, 1886; then an additional ten were put in place, and lastly, on August 18, forty stamps were dropping on the quartz of the mine. Owing to the favorable location, this mine can be opened by tunnels to a depth of about 1,600 feet. During the year the company has built a dam, separating the two larger lakes, 175 feet long, 25 feet high, and 52 feet at the base, at a cost of $8,000.

Altitude, feet	7,400
Number of stamps	40
Weight of stamp, in pounds	750
Drop of stamps, in inches	7
Drop of stamps, per minute	80
Duty of stamp in 24 hours, tons crushed	2
Average width of vein, in feet	5½
Size of screens, slot	7
Width of apron plates, in inches	48
Width of sluice plates, in inches	15
Total length of plates, in feet	800
Miner's inches of water used, per diem	30
Pressure of water, in feet	230
Cost of mining, per ton	$2 00
Cost of milling, per ton	$0 75
Percentage of recovery saved in batteries	95
Percentage of recovery saved on plates	5
Number of men in mine	50
Number of men in mill	8
Total number of men employed	90
Length of No. 1 tunnel, in feet	960
Length of No. 2 tunnel, in feet	1,160
Length of No. 3 tunnel, in feet	75
Depth of shaft on incline to No. 2 tunnel, feet	606
Length of ore-shoot, so far as explored, in feet	625

ALASKA MINE,

Is located at Pike City, at an altitude of 3,800 feet above sea level, and is one of the most prosperous mines in the county. The course of the vein is northeast and southwest, averaging 3 feet in width, with nearly a vertical dip. The claim is 4,200 feet, linear measurement, and is worked through a shaft 457 feet in depth. Levels are run at a depth of every 100 feet, the two longest being 2,000 feet each in length, and are still being extended. The developments made during the year are 1,500 feet of levels and 300 feet of upraises. Formation of the foot-wall is slate, and of the hanging-wall, slate and porphyry. The mill is 40-stamp, run by steam. Each stamp weighs 850 pounds, falls 7 inches at the rate of 86 times per minute, and crushes 2¼ tons every 24 hours. The apron plates are 30 by 52 inches, sluice plates 24 inches wide by 14 feet in length to each battery, pitching 1¼ inches to the foot.

The sulphurets are principally iron pyrites, but not of sufficient value to save; 65 per cent of the yield is saved in the batteries, and 35 per cent is collected on the outside plates.

Altitude, feet	3,800
Number of stamps	40
Weight of stamp, in pounds	850
Drop of stamps, in inches	7
Drop of stamps, per minute	86
Duty of stamp in 24 hours, tons crushed	2¼
Size of screens	No. 6
Cost of mining, per ton	$3 50
Cost of milling, per ton	$0 75
Percentage of recovery saved in batteries	65
Percentage of recovery saved on plates	35
Number of men in mine	70

Number of men in mill	9
Total number of men employed in and about mine	100
Vertical depth of shaft, in feet	457
Average width of vein, in feet	3
Length of ore-shoot, in feet	2,000

TUOLUMNE COUNTY.

KELTZ GOLD QUARTZ MINE.

This property, occupying an altitude of 2.000 feet above sea level, in Tuolumne Mining District, is in a slate formation, of which both walls have the same character. The claim has an area of 1,500 feet by 600 feet; and the course of the vein is northeast and southwest, with an easterly dip from 30–40 degrees, and is about 2 feet wide. The ore is reduced in a 10-stamp water power mill, and 85 per cent of the gold recovery is saved in the batteries, whilst 15 per cent is collected on the outside plates. The sulphurets, averaging in value $200 per ton, are saved by the Cornish buddle; but the cost of extracting the gold is not yet known, as the concentrations are, for the present, held in reserve. The outside plates, two to each battery, are 14 inches wide by a total length of 48 feet, and an inclination of 1 inch in 14 inches.

Altitude, feet	2,000
Number of stamps	10
Weight of stamp, pounds	650
Drop of stamps, in inches	6
Drop of stamps, per minute	85
Duty of stamp in 24 hours, tons crushed	1
Size of screen, slot No.	9
Miner's inches of water used in mill in 24 hours	12
Pressure of water, in feet	500
Cost of mining, per ton	Not given.
Cost of milling, per ton	$0 75
Percentage of recovery saved in batteries	85
Percentage of recovery saved on outside plates	15
Percentage of sulphurets	2
Value of sulphurets, per ton	$200 00
Number of concentrators	1
Number of men in mine	12
Number of men in mill	2
Average width of vein, in feet	2
Length of ore-shoot, in feet	400
Length of adit level, in feet	355
Depth of shaft, in feet	300

SOULSBY GOLD QUARTZ MINE.

The mine is situated in Tuolumne Mining District, at an altitude of 2.880 feet above the level of the sea. in a granite formation, both walls being of the same. The claim is 3,200 feet, linear measurement. The course of the vein is north and south and almost vertical, but at times dipping slightly to the east, and is 12 inches wide. The percentage of sulphurets is very variable, sometimes reaching as much as 20 per cent, although the assay value seldom changes from about $50 per ton. The method of saving the sulphurets is in the Morris canvas-covered sluices, after which they are worked for the gold by pan amalgamation. The cost of extraction and the percentage recovered are not given.

The batteries save 90 per cent and the outside plates 10 per cent of the yield of free gold. For the collection of gold on the outside there is a double run of electro-silvered copper plates, 16 inches wide, with a total length of 32 feet and an inclination of 1 inch in 14.

Altitude, feet	2,880
Number of stamps	15
Weight of stamp, in pounds	750
Drop of stamps, in inches	6
Drop of stamps, per minute	85
Duty of stamp in 24 hours, tons crushed	1
Size of screen, brass wire	60
Miner's inches of water used in mill in 24 hours	50
Pressure of water, in feet	350
Cost of mining, per ton	Not given.
Cost of milling, per ton	$0 75
Percentage of recovery saved in batteries	90
Percentage of recovery saved on plates	10
Number of men in mine	30
Number of men in mill	3
Average width of vein, in feet	1
Depth attained by deepest shaft, in feet	730

THE BUCHANAN MINE.

The property consists of a consolidation of four claims, each 600 feet wide by a length of 1,500 feet. Both walls are schist, but at the lower level the hanging wall is a dyke—probably a diorite. The course of the vein is north, 70° east, and dips from 53° to 64° northeast; the average width being about 5 feet. The mine is worked to a depth of 500 feet, through an almost vertical shaft. The mill, containing 20 stamps, is run by steam power; the stamps weigh 850 pounds each, have a fall of from 7 to 7½ inches 90 times a minute, and crush, each, 2 tons of ore every 24 hours. Two of the batteries contain inside plates, where two thirds of the gold yield is recovered from the 10 stamps; the other 2 batteries do not contain inside plates. Of the outside plates the upper ones are 4 feet wide by 6 feet long, with an inclination of 5°, and are made of soft copper. The lower plates are 3 feet 8 inches wide, and, together with the upper plates, form a total length, to each battery, of 10 feet 11 inches, with an inclination of 6°. Seven inches below the lower end of the plates, are movable soft copper-lined boxes, 7 inches wide by 20 inches in length, and 1 inch deep. Following are troughs, inclining 5°, with silvered plates, 18 inches wide by a length of 16½ feet. The pulp on leaving the plates flows into the movable boxes, and thence into the sluices. Between the upper and lower plates there is a wooden space, 2½ inches wide.

Number of stamps	20
Weight of stamp, in pounds	850
Drop of stamps, in inches	7–7½
Drop of stamps, per minute	90
Duty of stamp in 24 hours, tons crushed	2
Size of screens, No.	8
Percentage of recovery saved in batteries	⅔
Percentage of recovery saved on outside plates	⅓
Percentage of sulphurets	1
Value of sulphurets per ton,	$120 00—$260 00
Number of concentrators, Frue	8
Number of men in mine	9–15
Number of men in mill	7
Length of ore-shoot, in feet	200
Depth of shaft, in feet	500

TABULAR STATEMENT OF MILLS.

Name and Locality of Mill.	Water or Steam Power	No. of Stamps	Weight of each Stamp, pounds	Drop of Stamps in Inches	Drop of Stamps per Minute	Number of Tons Crushed per Stamp in 24 hours	Number of Screens.
Amador County.							
Plymouth Consolidated.	Water	80	750	7	90–100	Av. 2	----------------
Plymouth Consolidated.	Water	40	1,000	7	90–100		----------------
Keystone	Water	40	750	7–8½	96	2½	8 slot.
South Spring Hill	Water	20	750	6–7	90	2½	7 slot.
Stewart	Water	40	850	7	85	4½	6 slot.
Moore	Water	10	850	7	90	3	6 slot.
Downs	Water	20	600	8	85	1¼	9 and 10 slot.
Mammoth Tunnel	Water	10	750	8	90	2½	6 slot.
Zeile	Water	40	750	7½	87–88	3 37/100	4 slot.
Calaveras County.							
Stickles	Water	20	900	7	80	3¾	9 slot.
Utica	Water	20	950	8–9	80	3	9 slot.
Deep Lead	Water	8	750	9	85–87	Carloads, 5	5 mesh.
Sheep Ranch	Steam	30	800	8	85	2¼	9 slot.
Fine Gold	Water	10	750	6	100	2 1/10	40 mesh.
Oro Plata, stamps	Water	15	750	6–8	96	2 6/10	5 slot.
Oro Plata, Tustin Mill*	Water	-----	-----	-----	-----	-----	20 mesh.
El Dorado County.							
Springfield	Water	15	600	9	90	1¾	----------------
Fresno County.							
Abbey	Steam	10	800	5	96	2	9 slot.
Nevada County.							
North Star	Water	20	850	7	90	2	Experimenting.
Idaho	Water	35	850	9	72	2 85/100	5 slot.
Empire	Water	40	850	7	95	2	Experimenting.
Providence	Water	40	750	6–8	93	2	5 round punched.
Con. Wyoming	Water	16	800	7	92	2	----------------
Nevada City	Water	20	750	7–9	93	1¾	5 round punched.
Delhi	Water	8	1,000	6	94	3¼	5 round punched.
Eagle Bird	Water	20	750	6–7	95	1½	40 mesh.
Spanish †	Water	-----	-----	-----	-----	-----	6 slot.
Sierra County.							
Sierra Buttes	Water	60	850	8	86	2⅓	7 slot.
Young America	Water	40	750	7	80	2	7 slot.
Alaska	Steam	40	850	7	86	2¼	6 slot.
Tuolumne County.							
Soulsby	Water	15	750	6	85	1	60 brass wire.
Keltz	Water	10	650	6	85	1	9 slot.
Buchanan	Steam	20	850	7–7½	90	2	8 slot, 8 wire.

* Four mills; revolutions per minute, 20; number of tons crushed per mill in 24 hours, 10–11.
† Four Huntington Mills; revolutions per minute, 60; number of tons crushed per mill in 24 hours, 30.

CONCLUSION.

The Mining Bureau having received so many inquiries for a description of the mining machinery in use at the mines, the State Mineralogist deemed it necessary to make himself acquainted with the practical details thereof by personal inspection as far as possible, and by contribution where circumstances would not admit of individual attention. All of the information has been carefully gathered, and that portion pertaining to the inquiries received at the Bureau has been especially tabulated.

One of the chief difficulties, for reasons heretofore given, has been to collect a correct statement of the value per ton of the ore worked at the mills; therefore mention is only made of that of the smallest assay value to show how low a grade can be profitably treated when done systematically.

Since the report has been made ready for the press there has been received at the Bureau the "Mines Statement of the Minister of Mines of New Zealand," from which the following is an extract:

"During my occupancy of the office I have the honor to hold in connection with mines, I have felt the want of a hand-book that, at a glance, would give to the inquirer every information in respect to mining companies and claims, the mode of working, and the class of machinery used in different mining districts, the area of ground, the number of miners employed, and the amount of capital invested in plant and machinery.

"Following my instructions the Department has been engaged in collecting material necessary for compiling such work, and, when ready, I propose to issue illustrative maps with it, so that it will afford every possible information in relation to the industry. I cannot pretend that I shall be able to present for information a perfect work or guide, for difficulties have already been encountered in collecting reliable materials on which to frame the book; but, notwithstanding, I hope within a few months to be able to supply a much needed want."

It would seem from the above that the same difficulties in obtaining information exist elsewhere, and that the identical requests were made as have been received at the Bureau; therefore for these reasons the State Mineralogist has deemed it advisable to add to his report the contributions annexed, also inserting the United States mining laws and regulations thereunder for ready reference, and other matter and tables which are constantly needed.

BULLION PRODUCTION OF MINES OF CALIFORNIA,

For the twelve months ending January 1, 1886.

(Combined reported and unreported production, from the Report of the Director of the Mint, 1885.)

County.	Gold.		Silver.		Total.
	Reported.	Unreported.	Reported.	Unreported.	
Amador	$1,835,591 23	$310,000 00	$406 40		$2,145,997 63
Butte	422,568 50	250,000 00		$3,700 00	676,268 50
Calaveras	397,538 23	130,000 00	2,558 20		530,096 43
Colusa	40,000 00		5,000 00		45,000 00
Del Norte	24,390 00	15,000 00	9 18		39,399 18
El Dorado	383,353 85	35,000 00			418,353 85
Fresno	67,500 00	7,000 00	2,456 00		76,956 00
Humboldt	20,130 37	9,600 00			29,730 37
Inyo	7,498 04	17,500 00	59,961 49	13,500 00	98,459 53
Kern	22,003 00	50,000 00			72,003 00
Lassen	7,500 00	7,500 00	150 00		15,150 00
Los Angeles		22,500 00	445 00	1,500 00	24,445 00
Mariposa	87,177 00	62,000 00	100 00		149,277 00
Merced		10,000 00			10,000 00
Modoc		60,000 00			60,000 00
Mono	477,860 41	5,000 00	88,349 49	3,500 00	574,709 90
Napa			5,000 00		5,000 00
Nevada	1,138,873 68	1,439,000 00	4,835 43		2,582,709 11
Placer	507,801 51	398,500 00	411 43		906,712 94
Plumas	688,307 71	152,000 00			840,307 71
Sacramento	253,522 00	100,000 00			353,522 00
San Bernardino	3,000 00	20,000 00	2,283,436 37	80,000 00	2,386,436 37
San Diego	71,125 00	20,000 00		2,000 00	93,125 00
San Joaquin		2,500 00			2,500 00
Shasta	236,004 75	181,000 00	9,123 38	100,000 00	426,228 13
Sierra	1,060,380 97	373,500 00	10 54		1,433,891 51
Siskiyou	119,658 70	219,000 00			338,658 70
Stanislaus	18,660 00				18,660 00
Trinity	175,347 69	162,800 00	10 00		338,157 69
Tulare		7,500 00			7,500 00
Tuolumne	149,503 34	171,400 00	1,273 00	200 00	322,376 34
Yuba	132,448 73	75,000 00			207,448 73
Totals	$8,347,744 71	$4,313,300 00	$2,463,535 91	$104,500 00	$15,229,080 62

NUMBER OF INCORPORATED COMPANIES.

From the Government Roster issued by the Hon. Thomas L. Thompson, Secretary of State, it appears that from July 1, 1884, to July 1, 1886, there were filed in his office two hundred and six (206) articles of incorporation of companies for mining and milling purposes.

U. S. PATENTS.

Department of the Interior, General Land Office,
Washington, D. C., November 13, 1886.

Henry S. Durden, *Esq., Acting Secretary State Mining Bureau, San Francisco, California:*

Sir: I am in receipt of your letter of the twenty-eighth ultimo, requesting the total number of mines in the State of California for which patents have been issued.

In reply, I refer you to the following table showing the number of mineral and coal patents issued for claims in the State of California up to this date, as compiled from the records of this office:

Sacramento Land District	870
Stockton Land District	273
Susanville Land District	18
Shasta Land District	135
San Francisco Land District	87
Marysville Land District	162
Visalia Land District	18
Bodie Land District	152
Los Angeles Land District	43
Humboldt Land District	51
Total number of mines patented in the State of California	1,809

Very respectfully,

WM. A. I. SPARKS,
Commissioner.

HYDRAULIC MINES ENJOINED.

C. E. Sexey, Esq., of the Anti-Debris Association, has furnished the State Mineralogist with a partial list, showing twenty-three hydraulic mines which have been enjoined.

WELLS, FARGO & CO.'S STATISTICS.

Wells, Fargo & Company,
San Francisco, December 31, 1886.

Dear Sir: The following is a copy of our annual statement of precious metals produced in the States and Territories west of the Missouri River (including British Columbia, and receipts by express from the west coast States of Mexico) during 1886, which shows aggregate products as follows: Gold, \$30,773,759; silver, \$53,776,055; copper, \$9,276,755; lead, \$9,185,192. Total gross result, \$103,011,761.

As stated hitherto, the facilities afforded for the transportation of bullion, ores, and base metals, by the extension of railroads into mining districts, increase the difficulty of verifying the reports of the products from several important localities; and the general tendency is to exaggeration when the actual values are not obtainable from authentic sources; but the aggregate result, as shown herein, we think may be relied on with reasonable confidence as approximately correct.

States and Territories.	Gold Dust and Bullion by Express.	Gold Dust and Bullion by other Conveyances.	Silver Bullion by Express.	Ores and Base Bullion by Freight.	Total.
California	$12,579,356	$628,678	$918,403	$563.948	$14,690,385
Nevada	1,739,959	------------	5,502,596	1,927,365	9,169,920
Oregon	451,907	250,000	1,310	------------	703,217
Washington	139,694	25,000	------------	------------	164,694
Alaska	394.975	50,000	------------	------------	444,975
Idaho	1,816,500	300,000	2,602,000	3,015,000	7,733,500
Montana	2,100,000	500,000	7,840,000	10.400,000	20,840,000
Utah	19,140	------------	3,080,759	5,531,696	8,631,595
Colorado	3,500,000	------------	5,750,000	15,750,000	25,000,000
New Mexico	104,784	50,000	279,909	3,387,178	3,821,871
Arizona	583,827	100,000	1,371,083	4,048,468	6,103,378
Dakota	2,405,250	200,000	251,437	------------	2,856,687
Mexico (west coast States)	469,490	------------	1,627,204	12,000	2,108,694
British Columbia	692,845	50,000	------------	------------	742,845
	$26,997,727	$2,153,678	$29,224,701	$44,635,655	$103,011,761

The gross yield for 1886, shown above, segregated, is approximately as follows:

Gold	$29\frac{87}{100}$	$30,773,759
Silver	$52\frac{21}{100}$	53,776,055
Copper	$9\frac{00}{100}$	9,276,755
Lead	$8\frac{92}{100}$	9,185,192
Total		$103,011,761

Annual Products of Lead, Copper, Silver, and Gold in the States and Territories West of the Missouri River, 1870–1886.

Year.	Production, as per W. F. & Co.'s statements, including Amounts from British Columbia and West Coast of Mexico.	Product after deducting Am'ts from British Columbia and West Coast of Mexico.	The Net Product of the States and Territories West of the Missouri River, exclusive of British Columbia and West Coast of Mexico, divided, is as follows:			
			Lead.	Copper.	Silver.	Gold.
1870	$54,000,000	$52,150,000	$1,080,000	------------	$17,320,000	$33,750,000
1871	58,284,000	55,784,000	2,100,000	------------	19,286,000	34,398,000
1872	62,236.959	60,351,824	2.250,000	------------	19,924,429	38,177,395
1873	72,258,693	70,139,860	3,450,000	------------	27,483,302	39,206,558
1874	74,401,045	71,965,610	3,800,000	------------	29,699,122	38,466,488
1875	80,889,057	76,703,433	5,100,000	------------	31,635,239	39,968,194
1876	90,875,173	87,219,859	5,040,000	------------	39,292,924	42,886,935
1877	98,421,754	95,811,582	5,085,250	------------	45,846,109	44,880,223
1878	81,154,622	78,276,167	3,452,000	------------	37,248.137	37,576,030
1879	75,349,501	72,688,888	4.185,769	------------	37,032,857	31,470,262
1880	80,167.936	77,232,512	5,742,390	$898,000	38,033,055	32,559,067
1881	84,504,417	81,198,474	6,361,902	1,195,000	42,987,613	30,653,959
1882	92,411,835	89,207,549	8,008,155	4,055,037	48,133,039	29,011,318
1883	90,313,612	84,639,212	8,163,550	5,683,921	42,975,101	27,816,640
1884	84,975,954	81,633,835	6,834.091	6,086,252	43,529.925	25,183,567
1885	90,181,260	87,311,382	8,562,991	7,838,036	44,516,599	26,393,756
1886	103,011,761	100,160,222	9,185,192	9,276,755	52,136,851	29,561,424

The exports of silver during the past year to Japan, China, the Straits, etc., have been as follows: From London, $26,519,328; from Marseilles, $956,650; from Venice, $——; from San Francisco, $16,558,612. Total, $44,034,590, as against $56,109,949 last year. Pounds sterling estimated at $4 84.

UNITED STATES OF MEXICO.

Product of Gold and Silver in the Republic of Mexico from 1877 to 1886.

Years.	Gold.	Silver.	Total.
1877–1878	$661,385	$21,451,785	$22,113,170
1878–1879	662,524	21,405,330	22,067,854
1879–1880	474,632	23,383,448	23,858,080
1880–1881	380,301	23,583,135	23,963,436
1881–1882	382,752	24,009,525	24,392,277
1882–1883	380,419	22,921,921	23,302,340
1883–1884	420,000	24,240,000	24,660,000
1884–1885	385,000	25,037,356	25,422,356
1885–1886	450,000	26,000,000	26,450,000
Totals	$4,197,013	$212,032,500	$216,229,513

Exhibit of Coinage of Gold, Silver, and Copper in the Republic of Mexico, from the first of July, 1872, to the thirtieth of June, 1886, indicating approximately the Precious Metal product of the country for the years named.

Years.	Gold Dollars.	Silver Dollars.	Copper Dollars.
1872–1873	813,415	19,680,811	22,814
1873–1874	866,743	18,846,067	15,966
1874–1875	862,619	19,386,958	21,712
1875–1876	809,401	19,454,054	30,654
1876–1877	695,750	21,415,128	9,035
1877–1878	691,998	22,084,203	41,364
1878–1879	658,206	22,162,987	16,300
1879–1880	521,826	24,018,528	14,035
1880–1881	492,068	24,617,395	42,258
1881–1882	452,590	25,146,260	11,972
1882–1883	407,600	24,083,921	----------
1883–1884	355,724	22,812,000	----------
1884–1885	312,600	23,265,814	----------
1885–1886	425,000	25,850,000	----------
Totals	8,449,164	317,964,419	226,110

SUMMARY—TOTALS.

Gold	$8,449,164
Silver	317,964,419
Copper	226,110
Grand total	$326,639,693

Exhibit of the Coinage of Mexico from the Establishment of the Mints in 1537 to the end of the Fiscal Year of 1884–1885.

Dates of Coinage.	Gold.	Silver.	Copper.	Total.
Colonial Epoch.				
Unmilled coin from 1537 to 1731	$8,497,950	$752,067,456	$200,000	$760,765,406
Pillar coin, 1732 to 1771	19,889,014	441,629,211	----------	461,518,225
Bust coin, 1772 to 1821	40,391,447	888,563,989	342,893	929,298,329
Totals	$68,778,411	$2,082,260,656	$542,893	$2,151,581,960
Independence.				
Iturbide's Imperial bust, 1822–1823	$557,392	$18,575,569	----------	$19,132,961
Republic eagle, 1824 to June 30, 1873	45,040,628	740,246,485	$5,235,177	790,522,290
Totals	$45,598,020	$758,822,054	$5,235,177	$809,655,251
Republic.				
Eagle coin, July 1, 1872, to June 30, 1886	$8,449,164	$317,964,419	$226,110	$326,639,693

SUMMARY.

Colonial epoch, from 1537 to 1821	$2,151,581,960
Independence, from 1822 to 1872	809,655,251
Republic, from 1872 to 1886	326,639,693
Total	$3,287,876,904

The exhibits of production and mintage indicate a steady development of the mining interests of the United States of America, and also of Mexico, and with the increasing facilities of railway communications fostering every department of industry, the outlook for a continued growth in the product of precious metals is flattering.

JOHN J. VALENTINE,
Vice-President and General Manager Wells, Fargo & Co.

SAN FRANCISCO MINT.

COINAGE OF THE SAN FRANCISCO MINT FOR THE YEAR ENDING JUNE 30, 1886.

Gold, 1,455,550 standard ounces	$27,080,000 00
Silver, 42,051$\frac{32}{100}$ standard ounces	49,066 20
Total value	$27,129,066 20

TABLE OF CHARGES.

Mint of the United States at San Francisco, on all bullion (or coin) not required to be parted or refined:

For each melt of 1,000 ounces or less	$1 00
For each melt over 1,000 ounces	One tenth of 1 cent per ounce.

PARTING AND REFINING CHARGES.

PARTING GOLD AND SILVER OR REFINING GOLD.

Rate per ounce gross.

Bullion containing less than 200 M gold	2 cents.
Bullion containing from 200 M to 399$\frac{1}{2}$ M gold	3 cents.
Bullion containing from 400 M to 699$\frac{1}{2}$ M gold	4 cents.
Bullion containing 700 M and over gold	6 cents.
Bullion containing over 100 M base metal, additional	$\frac{1}{2}$ cent.

And in addition to the above, on deposits requiring parting (except silver purchases) or refining gold:

For each deposit of 1,000 ounces or less	$1 00
For each deposit over 1,000 ounces	One tenth of 1 cent per ounce, gross.

For gold coin or standard gold bars the rate per ounce charged will be imposed only on the number of ounces required to be refined to raise the whole to standard.

Silver allowed the depositor is calculated on the basis of refining the gold to 990 M.

REFINING SILVER.

Rate per ounce, gross.

Bullion containing less than 897 M silver	2 cents.
Bullion containing 897½ M to 979½ M silver	1½ cent.
Bullion containing 980 M to 997 M silver	1 cent.

In addition to the above, on silver deposits requiring refining (except purchases) a charge on each deposit of—

1,000 ounces or less	$1 00
Over 1,000 ounces	One tenth of 1 cent per ounce, gross.

For standard or sterling bars the rate per ounce will be imposed only on the number of ounces required to be refined to raise the whole to the fineness of such bars.

Silver bullion below 997½ fine, not containing gold, deposited for fine bars, is subject to a refining charge.

Silver bullion deposited for bars, will be computed at $1 per standard ounce. Silver parted from gold deposits will be purchased at the rate fixed by the Director of the Mint, which at present, per ounce, is,

TOUGHENING CHARGE.

Gold bullion	½ to 2 cents per ounce, gross.
Silver bullion	¼ to 1 cent per ounce, gross.

ALLOY CHARGE.

On the number of ounces of copper required to reduce the bullion to a standard, 2 cents per ounce, Troy.

BAR CHARGE.

On bullion deposited for fine bars not required to be parted or refined, and for standard, sterling, or unparted bars:

Bars of fine gold, per $100 value	10 cents.
Bars of standard gold, per $100 value	10 cents.
Bars of fine silver, per ounce	¼ cent.
Bars of standard silver, per ounce, standard	½ cent.
Bars of sterling silver, per ounce	½ cent.
Bars of unparted bullion, per ounce, gross	½ cent.

No deposit of bullion is received of less than one hundred dollars, or so base as to be deemed unsuitable for the operations of the Mint.

TABLES FROM REPORT OF THE DIRECTOR OF MINT.

From the report of the Director of the Mint, upon the production of the precious metals in the United States, during the calendar year 1885, the following tables are published, from the compilation of the Treasury Department, Bureau of the Mint:

Statement showing the Value and Character of the Gold and Silver used in the Arts and Manufactures during the Calendar Year 1883, as reported by the persons and firms who had been addressed.

GOLD.

Manufactures.	Number Manufactur'g.	United States Coin.	Stamped United States or Refinery Bars	Old Jewelry, Plate, and other Old Material.	Foreign Coin.	Native Grains, Nuggets, etc.	Wire, or Rolled Plate.	Total Gold.
Watch-cases	32	$575,812	$2,976,550	$38,101	$1,508	$520	$5,817	$3,598,308
Watch-chains	14	374,997	286,884	1,907	600	135,410	27,202	827,000
Dental supplies	7	700	33,437	3,775				37,912
Pens	14	14,578	90,325	6,100	5,227	2,134	27,560	145,924
Instruments	45	68		3,568		621	942	5,199
Leaf	51	178,424	792,551	57,498	6,816	6,700	42,835	1,084,824
Plate	219	379,291	67,928	5,500	590	8,933	66,626	528,868
Spectacles	41	192,400	7,169	8,830	1,315	4,987	727	215,428
Chemicals	27	7,438	7,685	3,551	550	207	12,180	31,611
Jewelry and watchmakers' supplies	11	24,498	13,983	9,123		1,569	30,054	79,227
Jewelry and watches	2,273	3,125,738	2,861,149	738,688	177,794	541,306	458,745	7,905,163
Totals	2,734	$4,875,587	$7,137,661	$876,641	$194,400	$702,387	$672,688	$14,459,464

SILVER.

Manufactures.	United States Coin.	Stamped United States or R·finery Bars.	Old Jewelry, Plate, and other Old Material.	Foreign Coin.	Native Grains, Nuggets, etc.	Wire, or Rolled Plate.	Total Silver.	Total Silver and Gold.
Watch-cases	$35,200	$1,777,193	$31,937	$219	$1,000	$50	$1,845,599	$5,433,907
Watch-chains	524	14,768			6,790	1,462	23,544	850,544
Dental supplies	450	6,060				228	6,738	44,650
Pens	216	4,254	100	1,655	505		6,730	152,654
Instruments	931	3,752	693	755	864	6,995	13,990	19,189
Leaf	11	22,697	4,107	300	835	18,933	46,883	1,131,707
Plate	16,856	1,710,515	40,761	7,690	8,495	281,977	2,066,294	2,595,162
Spectacles	3,631	16,461	1,254	205	250	1,981	23,782	239,210
Chemicals	9	375,429	35,554	500	1,580	3,347	416,419	448,030
Jewelry and watchmakers' supplies	245	4,806	800		1,505	975	8,331	87,558
Jewelry and watches	158,564	616,237	106,745	142,949	49,733	23,992	1,098,220	9,003,383
Totals	$216,637	$4,552,172	$221,951	$154,273	$71,557	$339,940	$5,556,530	$20,015,994

Statement showing Value and Character of the Gold and Silver used in the Arts and Manufactures during the Calendar Year 1885, as reported by the persons and firms addressed.

GOLD.

Manufactures.	Number Addressed.	Replied.	Manufacturing.	United States Coin.	Stamped United States or Refined Bars.	Foreign Coin.	Old Jewelry, Plate, and other Old Materials.	Native Grains, Nuggets, etc.	Wire or Rolled Plate.	Total.
Chemicals	341	219	39	$32,040	$13,903	----	$6,063	$29	$4,341	$56,376
Platers	634	348	226	257,741	218,831	$801	178,510	24,295	15,537	695,715
Gold pen manufacturers	34	22	11	7,433	34,886	2,867	990	3,526	6,753	56,455
Gold and silver leaf	72	51	46	58,150	527,453	2,000	31,050	19,700	39,001	677,354
Dental and surgical instruments	154	98	47	3,970	149,186	100	14,942	2,400	4,188	174,786
Spectacles and opticals	383	217	79	52,707	62,420	642	16,269	314	2,291	134,643
Miscelleneous	106	73	27	116,604	44,168	8,000	17,337	1,000	3,835	190,944
Jewelry and watches	6,330	3,352	2,232	2,298,733	5,183,187	164,503	582,554	451,629	485,241	9,165,847
Totals	8,054	4,380	2,707	$2,827,378	$6,234,034	$178,913	$847,715	$502,893	$561,187	$11,152,120

SILVER.

Manufactures.	Number Addressed.	Replied.	Manufacturing.	United States Coin.	Stamped United States or Refined Bars.	Foreign Coin.	Old Jewelry, Plate, and other Old Materials.	Native Grains, Nuggets, etc.	Wire or Rolled Plate.	Totals.
Chemicals	----	----	----	$91	$305,165	----	$73,561	$106	$2,165	$381,088
Platers	----	----	----	32,824	1,990,587	$25,434	43,191	12,798	157,922	2,262,756
Gold pen manufacturers	----	----	----	55	3,191	----	249	558	5	4,058
Gold and silver leaf	----	----	----	----	21,881	----	708	20	23,512	46,121
Dental and surgical instruments	----	----	----	4,682	107,717	1,401	7,057	4,450	2,494	127,801
Spectacles and opticals	----	----	----	2,587	42,424	155	2,750	210	942	49,068
Miscellaneous	----	----	----	838	5,330	----	268	70	1,017	7,523
Jewelry and watches	----	----	----	92,567	1,360,308	35,718	117,629	85,060	28,716	1,719,998
Totals	----	----	----	$133,644	$3,836,603	$62,708	$245,413	$103,272	$216,773	$4,598,413

Consumption of Gold in the Industrial Arts in the United States.

Fiscal Year.	Estimate of Director of the Mint. Consumption of United States Gold Coin.	Estimate by Mr. Muhleman, of consumption of Gold Coin and Bullion.
1874	* $30,000,000	$12,600,000
1875		12,900,000
1876		13,900,000
1877		15,300,000
1878		15,200,000
1879		15,900,000
1880		16,700,000
1881	3,300,000	17,800,000
1882	2,700,000	18,000,000
1883	2,500,000	17,500,000
1884	4,875,000	17,000,000
1885	5,000,000	15,600,000
Totals	$48,375,000	$188,400,000

* Includes short estimates for 1881–1882, and 1883.

*Annual Industrial Consumption of Gold and Silver by the Principal Nations of the World, from Latest Authority.

Countries.	Population.	Gold. (Fine ounces.)	Value.
United States (Burchard)	58,000,000	626,925	$13,000,000
England (mean of several authorities)	36,000,000	546,550	11,500,000
France (Dumas)	37,000,000	401,875	8,600,000
Germany (Soetbeer)	45,000,000	385,800	8,200,000
Switzerland (Lardy)†	2,846,000	321,500	6,600,000
Austria-Hungary (Nibauer)	37,800,000	----------	----------
Other countries (Soetbeer)	230,000,000	450,100	9,500,000
Totals	446,646,000	2,732,750	$57,400,000

Countries.	Silver. (Fine ounces.)	Coining Value, $1.2929.	Total Value of Gold and Silver.	Per Capita. Gold.	Per Capita. Silver.
United States (Burchard)	3,697,250	$4,000,000	$17,000,000	$0 22.4	$0 07
England (mean of several authorities)	2,604,150	3,000,000	14,500,000	32	08.3
France (Dumas)	2,411,250	2,800,000	11,400,000	23.8	07.5
Germany (Soetbeer)	2,636,300	3,000,000	11,200,000	18.2	06.6
Switzerland (Lardy)*	835,900	1,000,000	7,600,000	2 31.8	35
Austria-Hungary (Nibauer)	835,900	1,000,000	1,000,000	--------	02.9
Other countries (Soetbeer)	3,697,250	4,000,000	13,500,000	04.1	01.7
Totals	16,718,000	$18,800,000	$76,200,000		

*Consumption as cited by Ottomar Haupt. "L'Histoire Monétaire de Notre Temps;" Paris, pp. 21, 22.

†According to the census of Switzerland of 1870, the annual production of watches in that country for that year was 1,600,000, representing a total value of 88,000,000 francs. Thirty-seven thousand nine hundred and sixty-nine persons were reported to be engaged in the business of watch-making in the four cantons of Switzerland famous for that industry. Larousse Dictionnaire Universel, vol. 14, p. 1221.

PRODUCTION OF QUICKSILVER IN CALIFORNIA FOR THE YEAR 1885.

Compiled by J. B. Randol, New Almaden, California.

	Ætna.	Napa C.	Great Western.	Guadalupe.	New Idria.	Sulphur Bank.	Redington.	Great Eastern.	Various.	Total—flasks.	New Almaden.	Grand Total—flasks.	Price in San Francisco—per flask. Highest.	Lowest.
January	189	131	172	0	190	24	40	37	0	783	1,700	2,483	$33 00	$32 50
February	96	180	245	35	70	85	24	75	0	810	1,506	2,316	32 50	32 50
March	88	145	314	0	80	83	0	33	19	762	1,500	2,262	32 50	31 00
April	142	145	340	0	80	69	0	37	0	813	2,003	2,816	31 00	30 00
May	62	190	269	0	75	194	0	0	3	793	2,000	2,793	29 00	28 50
June	112	250	330	0	62	91	50	63	5	963	1,750	2,713	30 00	29 00
July	45	191	321	0	75	209	43	50	10	944	1,750	2,694	30 00	29 75
August	118	175	324	0	80	150	49	0	47	943	2,104	3,047	29 75	29 50
September	201	180	347	0	95	85	57	0	77	1,042	1,936	2,978	30 50	29 50
October	52	185	236	0	85	123	42	65	82	870	1,598	2,468	30 50	30 00
November	54	190	292	0	122	61	43	43	87	892	1,576	2,468	30 00	29 75
December	150	235	279	0	130	122	37	43	62	1,058	1,977	3,035	32 00	30 00
Totals	1,309	2,197	3,469	35	1,144	1,296	385	446	392	10,673	21,400	32,073	$32 00	$28 50
Production in 1884	2,931	1,376	3,292	1,179	1,025	890	881	332	7	11,913	20,000	31,913	$35 00	$26 00
Production in 1883	*	5,890	3,869	84	1,606	2,612	1,894	1,669	101	17,725	29,000	46,725	28 50	26 00
Production in 1882	....	6,842	5,179	1,138	1,953	5,014	2,171	2,124	241	24,662	28,070	52,732	29 05	27 35
Production in 1881	....	5,552	6,241	5,228	2,775	11,152	2,194	1,065	584	34,791	26,060	60,851	30 75	27 90
Production in 1880	....	4,416	6,442	6,670	3,209	10,706	2,139	1,279	1,600	36,461	23,465	59,926	31 45	27 55

San Francisco, December 31, 1885.

* Production of Ætna and Napa Con. not segregated in former years.

PRODUCTION OF QUICKSILVER IN CALIFORNIA IN THE YEAR 1886.

Compiled by J. B. Randol, New Almaden, California.

	Ætna.	Napa C.	Great Western.	Guadalupe.	New Idria.	Sulphur Bank.	Redington.	Great Eastern.	Various.	Total—flasks.	New Almaden.	Grand Total—flasks.	Price in San Francisco—per flask.	
													Highest.	Lowest.
January	162	147	339	0	70	100	42	73	34	967	1,431	2,398	$32 50	$32 00
February	132	192	274	0	175	108	24	53	45	1,003	1,100	2,103	32 50	32 50
March	209	218	226	0	20	91	21	43	75	903	1,522	2,425	33 00	32 50
April	328	172	115	0	90	172	36	62	62	1,037	1,256	2,293	33 00	33 00
May	228	128	99	0	101	36	18	76	95	781	1,600	2,381	34 00	33 00
June	276	123	126	0	110	113	19	71	78	916	1,806	2,732	36 00	34 00
July	345	138	138	0	95	98	24	64	127	1,029	1,572	2,601	37 00	36 00
August	313	74	156	0	105	119	35	76	84	962	1,240	2,202	37 00	36 75
Totals	1,993	1,192	1,473	0	766	837	219	518	600	7,598	11,527	19,135	--------	--------

HYDROMAGNESITE, FROM LIVERMORE, CALIFORNIA.

(Analyzed and contributed by F. Gutzkow, E.M.)

Moisture	.75
Silica, Alumina, Ferric oxide	1.25
Lime	Trace.
Magnesia	43.00
Carbonic acid	36.30
Water (in combination)	18.70
	100.00

Calculated for the pure mineral:

Magnesia	43.88	4 MgO
Carbonic acid	37.04	3 CO_2
Water (in combination)	19.08	4 H_2O
	100.00	

MINE DRAINAGE.

(By Chas. G. Yale.)

The principal methods employed for extracting water from mines in California and on the Pacific Coast, generally are: Cornish pumps, bailing tank, steam (or compressed air) pumps, and hydraulic pumps. For shallow mines, where there is little water, iron water buckets are used. The best form is made barrel-shaped, for use in shafts or winzes, where there are no guides—this shape preventing them from catching on projecting timbers or rocks. The water bucket has a fixed bale, as this bucket does not turn over, but is emptied by lowering until a spindle in its bottom rests on the bottom of the water box, when the spindle opens the valve in bucket bottom. This valve opens automatically when filling, and automatically closes when the bucket begins to rise. Oval and cylindrical bailing buckets are also made for work in vertical shafts, and are arranged with shoes for wooden shaft guides. They are sometimes arranged for rope guides, also. Rectangular baling tanks are also made, arranged for self-dumping. These tanks are so constructed as to discharge themselves on arriving at the station, without reversing the engine, and there is no man required to let the water out. Such tanks are made for wooden shaft guides.

Water skips are of the same character for inclined shafts. The bale is attached to a pivot back of the center of gravity, so that it will tip when it is run over the dumping track. The dumping is accomplished by making the rear wheels with a projecting face of smaller diameter, which catches on the dumping track and elevates the back end, and the skip is thus tipped to a proper angle for dumping. When lowering, the rear wheels must necessarily pass down first, returning the skip to its proper position. These and self-dumping skeets can be used for ore and water both, or either. The self-dumping skeets are designed for use in vertical shafts. For sinking purposes they are very handy, for they can be shoveled into or bailed into. In many cases, pumping from the bottom of a shaft while sinking can be dispensed with, as the water and dirt can be put into the skeet at the same time. These skeets are made with steel or iron boxes, and with single or double bar frames, made of Norway iron. They are self-dumping. The following tables show the various sizes, capacities, and

weights of the forms of tanks referred to, as given by the Risdon Iron Works of San Francisco:

Oval Bailing Tanks.					Cylindrical Bailing Tanks.			
Lesser Diameter. Inches.	Greater Diameter. Inches.	Height. Inches.	Capacity. Gallons.	Weight. Pounds.	Diameter.	Height.	Capacity. Gallons.	Weight.
30	40	60	245	875	30	60	180	775
32	42	72	330	1,050	30	66	198	820
36	48	84	490	1,400	30	72	216	865
42	48	96	650	1,750	36	60	265	1,350
42	54	96	700	1,950	36	66	290	1,400
					36	72	315	1,460
					36	78	340	1,530

Rectangular Self-Dumping Bailing Tanks.					Ore and Water Skips.		Self-Dumping Skeets.	
Width. Inches.	Length. Inches.	Height. Inches.	Capacity. Gallons.	Weight. Pounds.	Capacity. Cubic Feet.	Weight. Pounds.	Contents. Cubic Feet.	Weight. Pounds.
32	42	72	420	1,400	10	500	20	1,700
36	48	84	620	1,800	15	700	30	2,000
42	48	96	820	2,400	20	900	40	2,400
42	54	96	940	3,000			50	2,600
42	60	108	1,180	4,000			60	2,800
							70	3,000

Tanks of this character will handle a great deal of water, and can be replaced by cages when not needed. They are too simple to get out of order often and are readily repaired. In many places they are preferred to pumps, and are frequently kept in readiness as a substitute for Cornish pumps when the rods of the latter break.

Local practice varies greatly as to the means adopted for handling water. Some one form of pump does well in the first of the mines of the camp useing one, and others follow the example set. Cornish pumps are more frequent in older mining districts than in newer ones, and in larger mines than in smaller ones.

In the earlier history of mining on this coast, neither great depths nor great quantities of water had to be considered. A simple hurdy-gurdy water wheel, driven by a jet from a high head, was the prime mover. A pump-bob of simple construction and a bucket-lift, all of wood, was the shaft work. Many a rig like this may still be seen running in the smaller mines. In the quartz mines steam power was used, mainly geared engines, driving a line of plunger pumps. As the mines increased in depth, and larger quantities of water had to be handled, large engines and heavy gears came into vogue. In draining very great depths, the heavy weight of the pit-work, which is of so much importance in any direct-acting system, proves the destruction of the geared system; since in working geared pumping engines at great depths with heavy pit-work, the speed must be very slow. Geared engines for great depths have, therefore, the pumps very large and are run at very slow motion, otherwise frequent breakages would condemn the whole system.

For deep mine pumping the Cornish bucket and plunger pumps are very extensively used. They are driven from the surface by a system of gear-

ing directly connected with the engine shaft. The main gear is connected to the head of the bob, by a pitman, one end of which engages into a wrist-pin set into one of several bosses cast on to the arms of the main gear, so placed as to give any desired throw to the pumps. Where the depth of the shaft is so great that one pump is insufficient to raise the water to the surface, a system of two or more pumps is made use of, the lowest one pumping into a tank station at a convenient height above it, from which the pump next overhead in its system takes its suction and discharges either into a similar tank or directly out at the surface.

For depths below 300 or 400 feet, and for the handling of large volumes of water, the pumps generally preferred are those termed "Cornish bucket" or "Jack-head," and the plunger pumps. In the jack-head pump the working bucket is packed with leather, which is secured to the body of the bucket by a brass ring. The suction chamber is bolted directly to the lower end of the working barrel, and has the suction pipe and wind-bore bolted to its lower flange. The "goose-neck" bolts on the top of the barrel, and has a bonnet and stuffing box through which the bucket rod passes. The upper clack sets on the branch of the goose-neck, with the column bolted on its upper flange. The clack chambers have doors, through which the clacks are removed for repairs. A door is sometimes made in the goose-neck, through which the working bucket may be taken out without taking oft the bonnet from the top.

Jack-head pumps are best adapted for lifting water from cisterns or permanent sumps, although they are frequently used in sinking.

The common lift pump is different from the jack-head pump in that it has no goose-neck. The bucket-piece is bolted on the top of the working barrel, with a door for the removal of the bucket. On this, in a direct line, is set the column, with the pump-rods inside of it. The working bucket is the same as that for the jack-head pump. Of course there is only one clack. The advantage of these pumps in sinking is that the bucket can be lifted through the column for repairs while the whole pump is submerged in water.

The connecting rods through which the pump takes the motion are made of heavy timbers, strapped at the joints with iron plates and bolted through, and connect at the upper end with the pitman attached to the nose-piece of the bob. This pitman is furnished either with a cross-head or guide rollers, to keep it in position. The usual speed at which these pumps is run is about 12 strokes per minute.

The following table giving sizes, capacity, and horse power required for the various sizes of Cornish pumps, is furnished by the Pacific Iron Works, San Francisco:

Diameter of Plunger, in inches.	Length of Stroke, in feet.	Number of Strokes per Minute.	Gallons per Minute.	Horse power for each 100 feet Lift.
4	4	18	40	1
6	6	14	92	2
8	8	12	188	3½
10	8	12	294	5½
12	8	12	390	7½
14	8	12	576	11
16	8	12	752	14
18	8	10	793	16

The pumps employed in the deep shafts on this coast are all of the same general character, and do not differ materially in principle from

those used in deep mines in other countries. They are, as stated, either lifting pumps or force pumps. In a complete set of deep pumps the two kinds are combined, the former being applied to raising the water from the bottom of the shaft to the height adapted to the capacity of a single pump; the latter forcing the water upward to the stations, or to the point of discharge. The following descriptions of lifting and force or plunger pumps, from Hague's volume on "Mining Industry," in Clarence King's report on the United States Geological Exploration of the Fortieth Parallel, are very clear:

The lifting pump consists of a cast-iron cylinder or "working barrel," from 8 to 12 inches in diameter and from 8 to 12 feet long, smoothly turned inside, on which a closely fitting piston, that has an upward opening valve, may be made to move up and down by means of a rod to which it is attached. At the bottom of the cylinder is a valve opening upward, by means of which the water, once drawn from below into the cylinder, is retained there. Below the cylinder is the suction pipe, dipping below the surface of the water to be lifted. Above the cylinder is an iron pipe or column of elevation, in which the water is raised, by the upward movement of the piston, to any desired height. When the piston in the cylinder is moved upward, its valve remaining closed and the lower end of the suction pipe being immersed in the water, the pressure of the exterior air causes the water to rise in the suction pipe and to pass through the retaining valve, at the bottom of the cylinder, in accordance with the well-known principle involved in all suction pumps. On the downward stroke of the piston the retaining valve at the bottom of the cylinder closes, while the valve in the piston opens and the water passes through the piston. On the succeeding upward stroke the water now above the piston is lifted by it, while a new supply is drawn into the cylinder in the manner just described, to be lifted by the next upward stroke.

The pipe or column in which the water is raised above the piston is sometimes placed upon and directly over the cylinder, in which case the rod to which the piston is attached passes up through it, and is connected above with the motive power. But commonly the pipe, or column of elevation, is fixed at one side and connected by a short horizontal or curved piece with the cylinder, the top of which is then fitted with a stuffing box. The piston-rod then passes through the latter, and is then connected with the main pump-rod working on the shaft, from which it receives its motion.

The column may be of any desired height to which the strength of the material is adapted. As the lifting pump is generally only employed at the bottom of the shaft to raise the water to the force or power pump above, the height of the column varies with the circumstances. In shafts where sinking is in progress, the column of the lifting pump is constantly being extended as the shaft deepens, until a sufficient depth (200 feet or more) has been attained for the establishment of a force or plunger pump, when the lifting pump is detached from the column, the force pump put in its place at a suitable distance above the bottom, and the lifting pump again employed for sinking deeper with a short but gradually extending column.

The force pump or plunger pump forces the water upward in its column of elevation by the descent of the piston or plunger. This pump consists of a cast-iron cylinder or "plunger case," usually 10 or 12 feet long and from 8 to 12 inches in diameter, in which a solid cylindrical piston, nearly as long as the cylinder, is caused to play with an upward and downward motion; the piston passes through a stuffing box at the top of the cylinder, and is then connected with the pump-rod that gives it motion. Below the cylinder is a side or branch pipe connecting the cylinder with a valve-

chamber and the column of elevation. The valve in this chamber retains the water drawn through it from the wind-bore, or suction pipe, which is immersed in the cistern. The valve at the bottom of the column of elevation opens for the passage of the water into the column, and closes to retain it there. When the piston ascends the valve opens and the space in the cylinder, below the piston, fills with water; when the piston descends the valve closes and the other valve opens and the column of water is forced upward to the point of discharge to any desired height.

The piston or plunger of the force pump is a smoothly turned cylinder, 8 to 12 inches in diameter, and 10 to 12 feet long. It is cast hollow, of iron, about one inch in thickness. In order to attach it to the pump-rod, by which it is set in motion, a suitable stick of timber considerably larger than the piston is made to fit snugly into the inside of the cylinder, or hollow piston, entirely occupying the interior space; being driven tightly in it is wedged at the bottom. The top, projecting above the end of the cylinder, is then attached to the main pump-rod.

Another method is to have the plunger cast with a stout flange at the upper end, by means of which a head of cast-iron is bolted to it, carrying two uprights with a stout iron pin. To the end of the pump-rod is securely attached an iron stub-end, which is furnished with a strap, boxes, jib, and key, forming a connecting link such as is commonly used for attaching the connecting rod of an engine to the crankpin. By means of this link the pump-rod is attached to the pin in the head that is bolted to the plunger, as just described.

The plunger-case and valve chambers rest upon stout timbers, which are firmly established in the shaft in the most substantial manner. The column rests upon the valve chamber, and is itself further supported by timbers fixed at intervals in the shaft, and so arranged as to embrace the pipe directly under the flange by which the sections of the column are joined together, and furnish a bearing for these to rest upon. The pump column generally used at the more important pumping works, is a pipe having a diameter of 10, 12, or 14 inches. The best pipe column is of wrought iron, though cast pipe is very common.

It will be seen from the foregoing that the force pump performs its work of raising the water on the downward stroke of the piston, while the lifting pump does its duty on the upward stroke. The force pumps need to be very firmly set, and are, therefore, only employed where they can be permanently and solidly established in a position easily accessible for repair and not very liable to be submerged. The lifting pumps are well adapted to work in the bottom of the shaft, their method of construction and operation fitting them to draw water from the very bottom of the shaft without the use of a cistern, and to be extended, foot by foot, as the sinking proceeds; not requiring to be placed with so much care as the plunger pumps, and having the advantage also of being operated as well, even when the water rises above them in the shaft.

In order to extend the pump in depth as the sinking proceeds, the working parts of the pump, namely, the suction pipe and working barrel, being suspended by heavy chains to a turret or windlass fixed at the station above, are detached, with the connecting pipe, from the bottom of the column and lowered 10 or 12 feet, sufficiently to allow of introducing another length of pipe under the column, already in place; this additional length having been attached to the column, the working parts are again connected with the column thus extended, and are continued in operation until the sinking has so far progressed as to require the addition of another length of pipe, when the above described proceeding is repeated. In some

mines the suction pipe dipping into the sump is a stout piece of suction hose of diameter equal to that of the short iron pipe below the working barrel, to which it is closely fitted and attached. It has the advantage of flexibility and may be more easily protected against injury from blasting than iron pipe. The lifting pump discharges into a cistern from which the force pump takes its supply to be raised to the surface or to the next station above.

The motion of the piston, or plunger, in its cylinder, is imparted to it by the pump-rod, a continuous piece of timber, which is suspended in the shaft alongside the column, extending from the surface to the bottom of the mine, and to which the plungers are attached. The pump-rod is composed of timbers 6, 8, 10, or 12 inches square, or even larger, joined to each other so as to form a continuous piece. The method of joining the sections composing the rod varies in different mines. Sometimes they are joined by a simple splice, and strapped on four sides with long iron plates. In other mines the sections are joined in a more complicated manner by a beveled splice and key, and then strapped. In other cases the square ends of the sections are brought together without any splice, and joined simply by means of iron straps. Sometimes the straps are so formed that a key can be inserted. When these keys are driven in as tightly as possible, so as to bring the ends of the timbers closely together, and so prevent any lost motion in the action of the rod, the two straps for the remaining two sides are put on and bolted together.

The motion of the rod is communicated to it from the engine by means of an oscillating "bob" on the surface. These bobs are made of various forms, but correspond generally to the form of the "walking beam" of the old style marine engine. The method of connection with the engine also varies. The pumping engine drives, by means of the piston, the pump wheel, to one side of which is attached, by means of a wrist-pin, one end of the pitman. As the wheel is set in revolution by the engine, the pitman receives a reciprocating motion, the length of the stroke being determined by the distance of the wrist-pin from the center of the wheel. The other end of the pitman being connected to the kingpost of the bob, causes that to oscillate, giving to the pump-rod in the shaft an upward and downward motion. The upper section of the rod is usually connected to the "nose" of the bob and the next lower section of the rod by means of a strap and boxes, so as to allow for the vibration caused by the angular motion of the bob; deeper in the shaft the sections are joined together as described above, forming one continuous piece, which is guided in its movement by timbers so arranged as to prevent vibration of the rod. Timbers are also placed in the shaft at frequent intervals to prevent the rod from falling far in case of breakage, by furnishing support to the catching pieces attached to the rod for this purpose. The length of stroke, or upward and downward movement of the rod, varies from 3 or 4 to 7 or 8 feet, and the number of strokes per minute from 3 or 4 to 10 or 12, according to size and character of pump and duty required of it.

The weight of this pump-rod in most cases considerably exceeds that of the water to be raised, so that, descending by its own gravity, it exerts sufficient force to raise the column of water without requiring additional power from the engine. For the next stroke, however, the engine must lift the total weight of the rod to the required height. In order to prevent the too rapid descent of the rod and to equalize the work of the engine on either stroke, counter-weights are attached to the opposite end of the oscillating bob at the surface. The descending rod must raise the counter-weight, which, on the reverse stroke, assists in lifting the rod. For deep shafts, as

the rod increases in length and weight, additional counter-weights are applied, by establishing at various stations in the shaft similar oscillating bobs, attached at one end to the rod and bearing at the other a heavily weighted box. Angle bobs are used to change direction of motion, in changing from a vertical to an incline shaft. They are of various forms.

It is unnecessary in this instance to go into any description of the numerous forms of engines which are employed to drive this pumping gear. Different makers claim special advantageous features, and no one type is in exclusive use. The ordinary single-geared pumping engine has the pinion placed on the engine shaft, gearing into the spurwheel, to which a pitman rod is attached. In the double-geared engine two pinions are placed on an engine shaft and the pitman rod-pin is placed between the two spurwheels, thus adapting it for very heavy work. The simplest form of direct acting engines consists of a single high pressure cylinder connected directly to the main-bob; the king-post of this is larger than the nose piece, so as to give the engine leverage on the pumps. The valve gear is generally so arranged and adjusted that steam can be cut off at any portion of the stroke, or the stroke of the piston can be shortened. In some of the horizontal direct-acting compressed engines the pitman is connected directly to the crosshead and king-post, the connections between king-post and flywheel being made by two side rods.

Sometimes two lines of pump rods are used in the same shaft, working a double line of pumps from the same bob, in which case no counterbalance is necessary. Often, too, there is a double line of plunger pumps, when the main pump-rod extends down between the pumps to the next set below, and so on until the bottom pump is reached. An angle plate is attached to each side of the rod by bolts common to both, and to each of which the pump plungers are attached.

The ordinary surface bob is made principally of wood. The irons for the king-post and nose-piece are each made on two pieces, with sockets for angle-braces, and securely bolted together by bolts running through the timber. The saddle-plate is made in three pieces, and made to admit of the trunnion shaft being placed on a line with the nose and tail-pins. The trunnion shaft is made of hammered iron, and secured by running through the beam, and being keyed to the side and saddle-plates. The whole is drawn together by wrought-iron straps and turnbuckles. The back of the beam is extended to admit of a box being attached, to be filled with old iron, rocks, or other heavy substances, for a counterbalance. These bobs are sometimes made wholly of iron. The balance bobs, made for use under ground, also vary in form. Those interested in forms of bobs and methods of connection to engine, may see excellent illustrations of various forms in one of the business circulars issued by the Union Iron Works of San Francisco.

Recently, in this State, steam has been displaced by water power for running the pumping rig of several important mines.

It may be well to cite some examples of Cornish pumping rigs in California to illustrate capacity, etc. The examples are all taken from actual works in California mines:

A.—Cornish pumping rig driven by 80-horse power engine, which also hoists. In summer, pumps 4 hours in 24; in winter, constantly. Capacity, 14,000 gallons per hour; rod 1,000 feet. One 8-ton counterbalance at surface.

B.—Cornish pumping rig driven by 8-foot hurdy-gurdy wheel, using 12 inches of water at 400 feet fall. Capacity, 3,500 gallons; rod, 450 feet. One 3-ton counterbalance.

C.—Rig driven by hurdy-gurdy under-wheel, using 24 inches of water in summer, and 35 inches (about 30 h. p.) with 400 feet fall. Capacity, 10,000 gallons per hour. Rod, 410 feet; one 4-ton counterbalance. In winter a Hooker pump, with capacity of 10,000 gallons, is also used.

D.—Myers' cut-off Cornish pumping engine, 75 h. p. Rod, 500 feet. Two counterbalances weighing 11 tons.

E.—Compound Cornish engine, double acting, with two rods down to 400 feet, and single rod for 200 feet below; capacity, 22,500 gallons per hour. One 10-ton counterbalance.

F.—Cornish engine, 110 h. p. Capacity, 10,000 gallons per hour. Rod, 1,300 feet. Lever bobs, with counterbalances, together weighing 14 tons.

G.—Cornish engine, 80 h. p. Rod, 1,300 feet; two counterbalances, 2 tons each.

H.—Cornish rig run by water power. Jackhead pump operated by 400 feet of rod. One counterbalance.

I.—Cornish rig run by hoisting engine. Capacity, 30,000 gallons. Rod, 900 feet. One 4-ton counterbalance.

J.—Cornish pumping rig run by hoisting engine. Capacity, 6,000 to 7,000 gallons per hour; 500 feet force; 300 feet lift; one 1½-ton counterbalance.

Those desiring to examine details of very large rigs of this kind may see descriptions of those in use on the Comstock, Nevada, in volume XIII of the Census Reports, 1880, page 149.

A form of pumping apparatus recently introduced in California, is the Knight hydraulic pumping engine. It is specially designed for pumping water out of mines to any depth where there is water pressure above the drain tunnel. The hydraulic engine (or wheel) can be bolted to the shaft timbers at the drain tunnel, and a pump-rod run down to a special plunger pump made for use in connection with the Knight engine. By using this engine at the drain tunnel the gears, bob, etc., below, are saved. Both the engine and pump can be set on the same bed-plate if desired, and the whole apparatus secured in the shaft below the surface in drain tunnel. After operating the engine, the water is exhausted into the discharge pipe of the pump. The only gain in this is the doing away with the pump-rod. Nothing is gained in power.

Steam force or plunger pumps are now much more largely used than formerly, having been much improved and specially adapted for mining purposes. There are many forms kept on sale by various makers, among the best known being the Knowles, Blake, Dow, Hooker, Worthington, Cameron, Cope & Maxwell, and Deane. These and similar pumps are made in great variety of form and size, but are more or less similar in general appearance and design, the different makers, however, adopting details of construction originating from their special experience, or from their experience arising in practice under different conditions of use. For opening up mines, re-prospecting abandoned ones, working them under bond, temporarily, etc., the steam pumps are very advantageous. A steam pumping rig has the advantage of greatly reduced first cost over the Cornish system, and lately the makers of steam pumps claim equal economy with that plan. There is no doubt of one thing, that twice the number of mines have been opened lately, with steam pumps, than would have been the case had expensive Cornish rigs been absolutely necessary, the plant of steam pumps costing so much less originally. By their use a mine can be opened and tested. Moreover, there are many locations which it would not pay to test if steam pumps could not be obtained to do it with.

For a few thousand dollars a boiler and steam pump can be procured to drain a mine while prospecting it, when a Cornish rig of same capacity would cost four or six times as much.

The horizontal plunger pumps are mainly used for station pumps, and are made to raise the water on a single lift as high as 1,000 feet. The particular advantages of the direct acting system are the first cost, ready means of placing in position, etc., especially for prospecting purposes. The steam is brought down the shaft in jacketed pipes, and the pipe column brought up to the surface, the pump being below. The best makers now construct these pumps so the parts are readily accessible, muddy water can be raised, and have otherwise perfected them greatly.

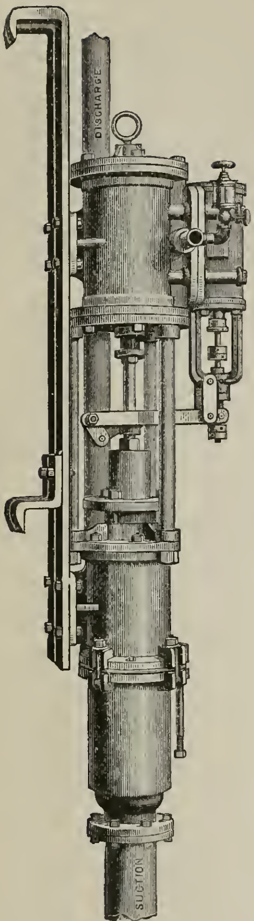
A class of vertical sinking steam pumps has come into use quite largely of late, having been much improved. Their peculiar feature is the special adaptability for shaft sinking purposes. They are of comparatively light weight, portable, and require a very limited space for operation. A steady continuous stream of water is thrown and there is very little jar. As an illustration of this class of pumps engravings are here given of the Dow double-acting vertical sinking pump. They operate in any position, whether suspended from the ringbolt attached to the steam cylinder head, hanging on timbers by means of the adjustable dogs founded for the purpose, or placed horizontally. The plunger barrel easily removed for substitution. A peculiarity of this pump is the suction condensers, the utility of which is an important consideration in sinking a shaft, as it not only consumes exhaust steam, avoiding the use of exhaust pipes leading out of the mine, or the damaging effect on the timbering if allowed to escape into the shaft, but is so constructed as to increase the efficiency of the pump by doing more work with a given amount of steam. A large one of this style was put in the Alaska Mine, Sierra County, not long since, to drain a flooded shaft which the other steam pumps were unable to do. A rig of this kind answers very well and its first cost is not great.

A recent application to vertical pumps of this class, by Mr. James E. Dow, of San Francisco, is a governor, so that if the water is lowered so air gets in, the pump cannot "run away" and be damaged. This new feature is an important one. With speed governor, and suction condenser, this type of pumps is greatly improved. None of these attachments are complicated, and may be managed by any ordinary mechanic. These and other improvements are overcoming former objections, and the modern "sinker" is a very convenient appliance. The engravings show two views.

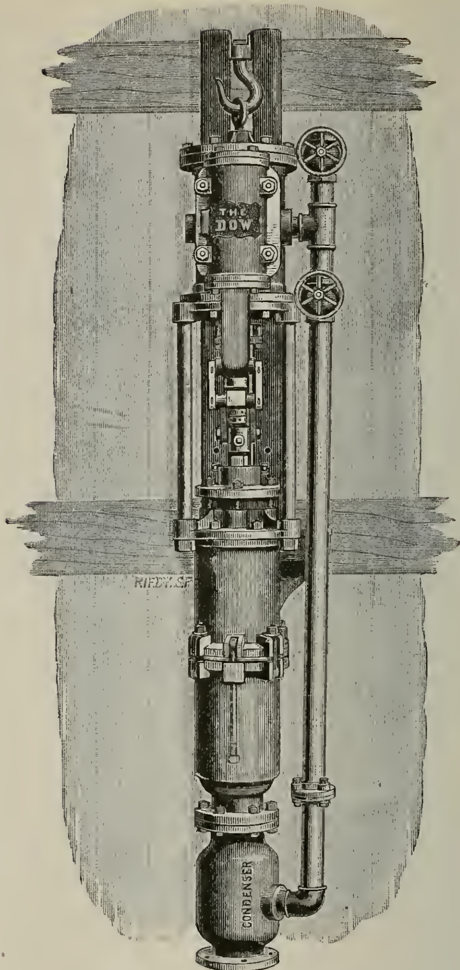
To give an idea of the data and prices of such pumps, the following table is appended:

Steam Cylinder.	Bucket.	Plunger.	Stroke.	Gallons per Stroke.	Capacity per Minute at Ordinary Speed.
6½	6	4¼	10	.61	100 strokes, 61 gallons.
8	6	4¼	10	.61	100 strokes, 61 gallons.
10	7	5	12	1.02	100 strokes, 102 gallons.
10	8½	6	12	1.47	100 strokes, 147 gallons.
12	8½	6	12	1.47	100 strokes, 147 gallons.
12	10	7	18	3.00	60 strokes, 180 gallons.
14	10	7	18	3.00	60 strokes, 180 gallons.
14	12	8½	18	4.42	60 strokes, 265 gallons.
16	12	8½	18	4.42	60 strokes, 365 gallons.
18	12	8½	18	4.42	60 strokes, 265 gallons.
18	14	10	24	8.16	50 strokes, 408 gallons.
20	14	10	24	8.16	50 strokes, 408 gallons.

Sizes of Pipes.				Space Occupied.	Weight.	Price.
Steam.	Exhaust.	Suction.	Delivery.			
1	1½	4	2½	17 × 20 × 74	850	$450 00
1¼	2	4	2½	17 × 21 × 74	900	475 00
1½	2	4	3	20 × 24 × 82	1,500	650 00
1½	2	5	4	23 × 26 × 82	1,900	700 00
2	2½	5	4	23 × 28 × 82	2,200	775 00
2	2½	6	5	27 × 29 × 122	3,000	900 00
2½	3	6	5	27 × 32 × 122	3,400	1,000 00
2½	3	8	6	29 × 33 × 122		
2½	3½	8	6	29 × 34 × 124		
3	4	8	6	29 × 36 × 124		
3	4	10	6	33 × 39 × 150		
3½	4½	10	6	34 × 40 × 150		



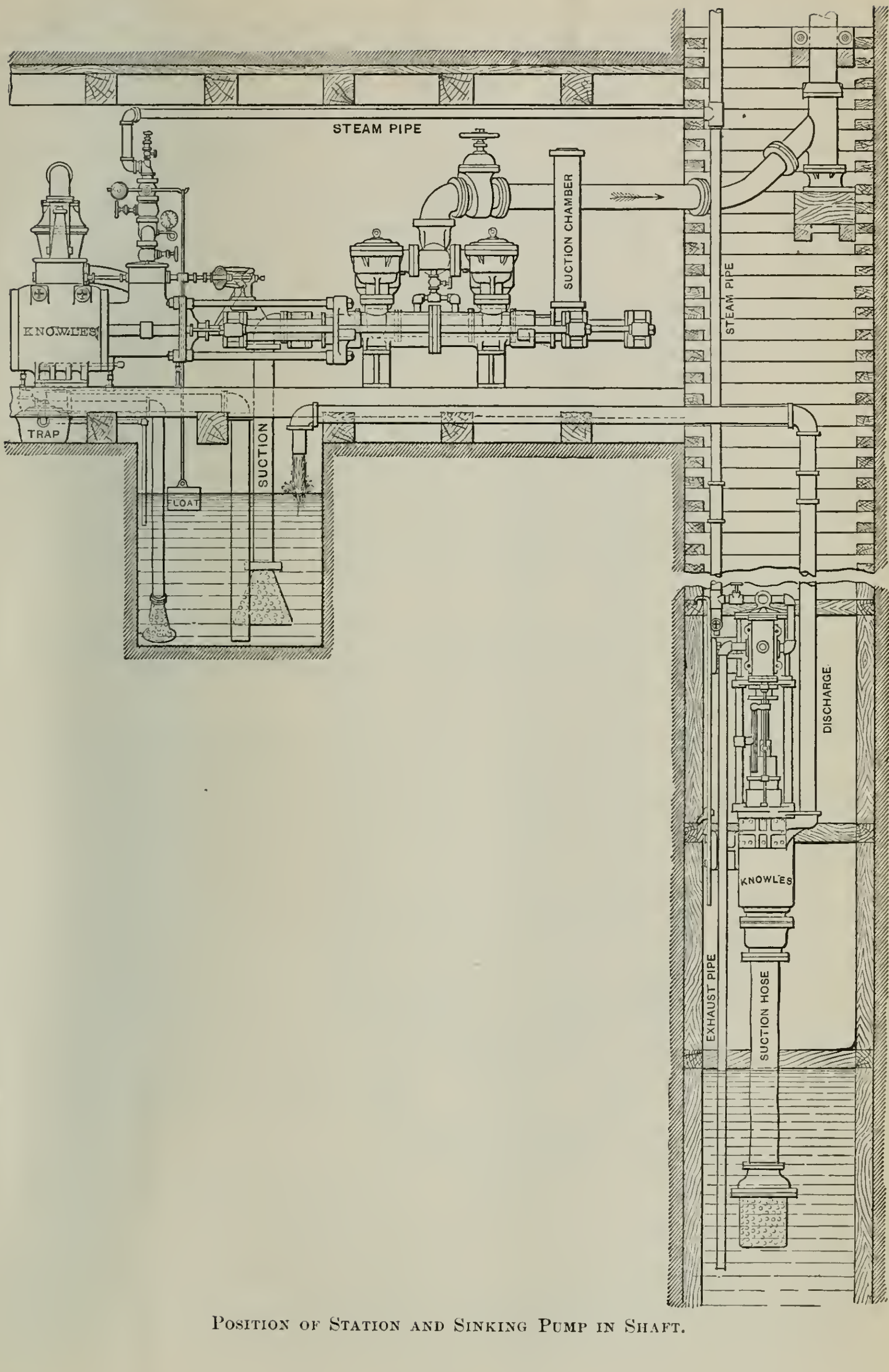
Side View.



Suction Condenser Attached.

VERTICAL DOUBLE–ACTING SINKING PUMP.

As illustrating the application of ordinary steam pumps to mines a sketch is here given showing a pumping station with the cistern, pumps, etc., the sinking pump being shown in the bottom of the shaft, where the suction hose extends into the shaft. The steam is brought down in jacketed pipes to operate the sinking pump, which takes the water up to the cistern in the station where the horizontal plunger pump is placed. This is operated, as the diagram shows, lifting the water from the cistern in the station to another similiar station above, where another pump is placed, or directly to the surface or point of discharge, according to height. In these Knowles pumps the exhausted steam is condensed by the water in the sump or cistern, as the pipes show; but recently another condensing feature has been attached. Many mines on this coast are provided with this sort of pumping rig.



Position of Station and Sinking Pump in Shaft.

In the very deepest mines on this coast, such as those on the Comstock, Nevada, it was found the weight of the pit work became so enormous that finally the rate of speed, which is determined by the weight of the mass set in motion, had to be decreased beyond all practicable working limits. The question then presented itself: What system of pumping can be adopted that will meet all difficulties that are ever present where heavy pumping works have to be constructed, and also meet the peculiar difficulties to be encountered in developing the great gold and silver bodies of ore in the Sierras? When the hydraulic system was suggested it was at first condemned, owing to the fact that it had never been tried, except in Europe, where mines of small depths had been drained. Finally, however, the managers of the Combination shaft decided to try it, and since then it has been successful on the Comstock, and several plants have been built.

The general plan of this system will be rendered plain to the reader by the accompanying drawings, and the following description, written by Robert S. Moore of the Risdon Iron Works, San Francisco:

By referring to the drawings of the general plan, it will be seen that the mine to which this system is applied, is 2,400 feet deep; also, that the water to be pumped is to be raised from the 2,400 level to a height of 800 feet and discharged into the Sutro Tunnel, through which it is run off. Upon the 2,400 level is erected a pair of hydraulic pumping engines (marked *P* in the drawing), which receive their pressure water through supply pipes from the surface. By these two pumps (as will be fully explained hereafter) the drain water is raised through discharge column to the Sutro Tunnel, and the water used in doing the work of pumping is sent back through the return pipe to a reservoir, *N*, on the surface. Upon the surface there is a cast-iron accumulator, *A*, which is 60 feet high and 25 inches in diameter. In this accumulator there are but 20 feet of water, the remaining space being occupied by air.

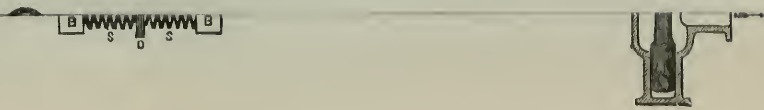
This air is kept constantly at a certain pressure by means of plunger pumps, *T*, which in turn are operated by a compound steam engine, *O*. These pumps, which supply the accumulator with water and keep it at a pressure great enough to run the two underground pumps, *P*, take their suction from the reservoir, *N*, into which the return water is discharged.

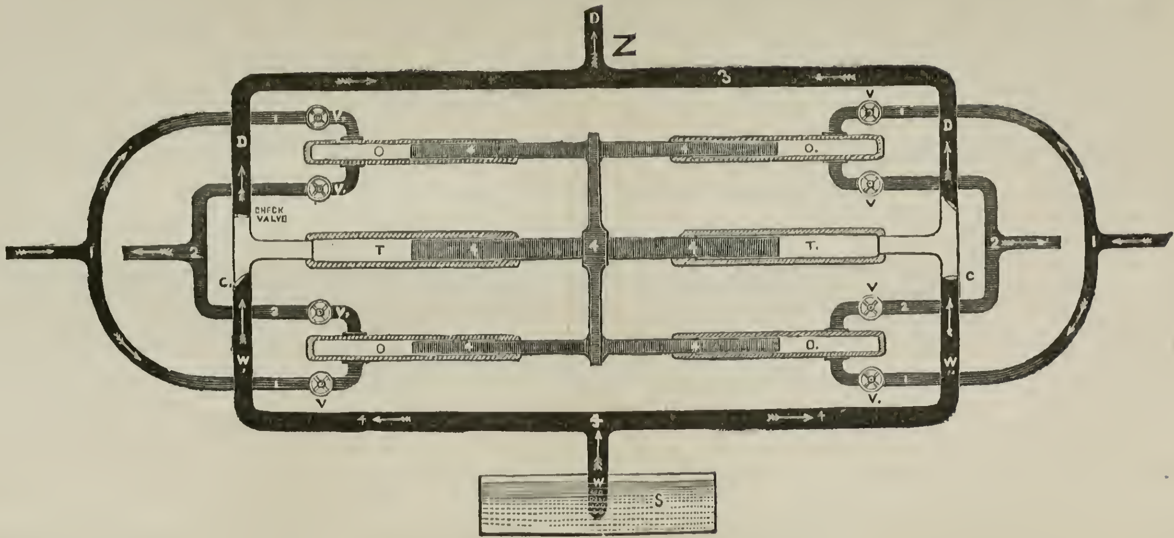
Now, since this pipe which supplies the pumps, *P*, is of such great length, and moreover, since the whole mass within it must be put in motion and brought to rest again during each stroke of the pumps, *P*, it is evident that some mechanical contrivance must be introduced for the purpose of lessening the jar in the pipes caused by the sudden stoppage of such an immense mass of water. The arrangement by which this end is accomplished, will be readily understood by referring to the drawings. It is constructed as follows: Let *E* (in general plan) be the valve which shuts off supply water from *P*. Close to the underground pumps there are firmly fixed two cast-iron cylinders, *C* and *C*, in which the plungers, *L*, *M*, carrying the crosshead, *D D*, are free to move. On either side of the arm, *D D*, are strong springs, *S*, *S*, held in position by the abutments, *B*, *B*. Now, when water in supply and return pipes is at rest, the arm, *D D*, is exactly in the middle between the cylinders, *C* and *C* (since the plungers, *L* and *M*, are so proportioned that the total pressure on *L* is precisely equal to total pressure on plunger, *M*). But after the underground pump, *P*, has completed its stroke, and the total mass of water in the supply pipe has to be brought from a velocity$=v$ to a velocity equal to zero, the inertia of this mass (due to velocity v) is supposed to be gradually reduced to zero by the plunger, *L*, *M*, being forced (on account of extra pressure on *L*) over to the right side. The distance it travels to the right depends, of course, upon the extra pressure produced by checking the velocity of supply water, and also upon the strength of the springs, *S*, which begin to be compressed as soon as *L M* begins to move. Now, after the crosshead has been forced over by this extra pressure to its maximum extent (the water in the three columns also coming to rest at this moment), the compressed springs, *S*, will immediately react to place the crosshead and plungers in their central position, ready to again take up the inertia of the mass in supply column on the return stroke of the pumps.

Thus, the object of these springs, *S*, *S*, is not only to assist the water in the return column in taking up the inertia of the water in the supply column, but chiefly to replace the plungers, *L*, *M*, in their central position after the masses in the three columns have come to rest.

The general arrangement of the system having been described, an account will now be given of the manner in which the work is performed by the pumps, *P*. In the drawing I have shown in detail that portion of the undergound pumps lying between the lines, *B* and *B*, on the general plan, leaving out, of course, that portion already explained for taking up the inertia of the supply water.

There are two of these underground pumps, situated on the 2,400 level of the mine, but since they are similar and work independently of each other, it is necessary to describe but one of them. They both take their supply water through the valve, *E*. Acting inde-





HYDRAULIC SYSTEM OF DRAINING MINES.

In the very deepest mines on this coast, such as those on the Comstock, Nevada, it was found the weight of the pit work became so enormous that finally the rate of speed, which is determined by the weight of the mass set in motion, had to be decreased beyond all practicable working limits. The question then presented itself: What system of pumping can be adopted that will meet all difficulties that are ever present where heavy pumping works have to be constructed, and also meet the peculiar difficulties to be encountered in developing the great gold and silver bodies of ore in the Sierras? When the hydraulic system was suggested it was at first condemned, owing to the fact that it had never been tried, except in Europe, where mines of small depths had been drained. Finally, however, the managers of the Combination shaft decided to try it, and since then it has been successful on the Comstock, and several plants have been built.

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This air is kept constantly at a certain pressure by means of plunger pumps, *T*, which in turn are operated by a compound steam engine, *O*. These pumps, which supply the accumulator with water and keep it at a pressure great enough to run the two underground pumps, *P*, take their suction from the reservoir, *N*, into which the return water is discharged.

Now, since this pipe which supplies the pumps, *P*, is of such great length, and moreover, since the whole mass within it must be put in motion and brought to rest again during each stroke of the pumps, *P*, it is evident that some mechanical contrivance must be introduced for the purpose of lessening the jar in the pipes caused by the sudden stoppage of such an immense mass of water. The arrangement by which this end is accomplished, will be readily understood by referring to the drawings. It is constructed as follows: Let *E* (in general plan) be the valve which shuts off supply water from *P*. Close to the underground pumps there are firmly fixed two cast-iron cylinders, *C* and *C*, in which the plungers, *L*, *M*, carrying the crosshead, *D D*, are free to move. On either side of the arm, *D D*, are strong springs, *S*, *S*, held in position by the abutments, *B*, *B*. Now, when water in supply and return pipes is at rest, the arm, *D D*, is exactly in the middle between the cylinders, *C* and *C* (since the plungers, *L* and *M*, are so proportioned that the total pressure on *L* is precisely equal to total pressure on plunger, *M*). But after the underground pump, *P*, has completed its stroke, and the total mass of water in the supply pipe has to be brought from a velocity=v to a velocity equal to zero, the inertia of this mass (due to velocity v) is supposed to be gradually reduced to zero by the plunger, *L*, *M*, being forced (on account of extra pressure on *L*) over to the right side. The distance it travels to the right depends, of course, upon the extra pressure produced by checking the velocity of supply water, and also upon the strength of the springs, *S*, which begin to be compressed as soon as *L M* begins to move. Now, after the crosshead has been forced over by this extra pressure to its maximum extent (the water in the three columns also coming to rest at this moment), the compressed springs, *S*, will immediately react to place the crosshead and plungers in their central position, ready to again take up the inertia of the mass in supply column on the return stroke of the pumps.

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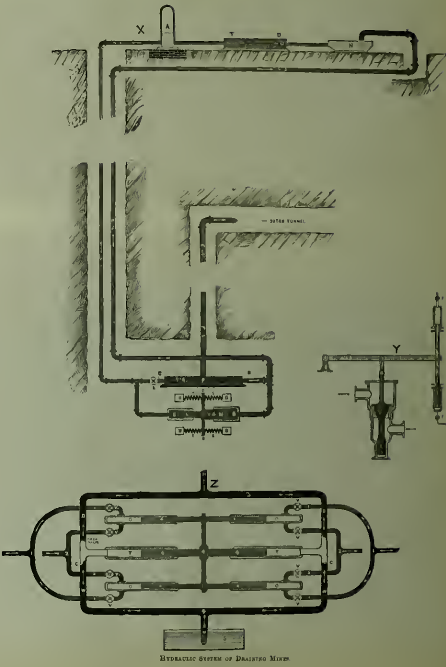


HYDRAULIC SYSTEM OF DRAINING MINES

pendently, as they do, they will not necessarily commence and finish their strokes at the same time. But, in order to discuss the system under its extreme conditions, I will consider the two pumps as working together, thereby making the velocity of the supply water and the inertia of the moving masses a maximum.

Therefore, in each pump, let *O*, *O*, and *O*, *O*, see detail drawing, be the four pressure cylinders, and *T* and *T* the pump cylinders for raising the drain water to the Sutro Tunnel. Let *V* and *V* be the valves leading to the pressure cylinders from the supply and return pipes, and let the plungers be connected with a crosshead (as shown in drawing), so that when any movement of the plunger, *O O*, takes place, the plunger, *T T*, will be carried along also.

Now, let us follow the operation of these pumps, first assuming, however, that the pressure of the water in the supply pipe is great enough to produce motion of the plungers, *O*, *O*.

First, suppose the valves, *V*, to be opened (valves, *V*, remaining closed). The two plungers, *O O*, will be forced over to the right, carrying with them the larger plunger, *T T*. While *T* travels to the right, the space left by it is immediately filled with drain water coming through the suction pipe, *W*. Now, suppose valves, *V*, be closed and the stroke finished, the valves, *V*, are then opened, and the pressure of the supply water against the plungers, *O*, forces them to the left, and the water remaining in cylinders, *O*, is forced through the valves, *V*, into the return pipe, and thence into reservoir, *N*, upon the surface. At the same time, the water which was drawn into cylinder, *T*, on preceding stroke, is now forced (on account of the check valve, *C*, closing) through *D* into discharge column, *D*, and thence 800 feet into the Sutro Tunnel. Again, while this stroke to the left is being made, the space left by plunger, *T*, is being filled with drain water through suction pipe, *W*. At the completion of this stroke, valves, *V*, are closed and valves, *V*, are opened, the crosshead and plungers again move to the right, and the waters remaining in the cylinders, *O*, is again forced through return column into reservoir, *N*. At the same time, the water in cylinder, *T*, is forced upward (on account of check valve, *C*, being closed) through *D* into *D*, and thence to Sutro Tunnel. When crosshead and plungers are again over to the extreme right, valves, *V*, are closed and valves, *V*, opened, and thus the operation continues, the valves, *V* and *V*, being worked automatically by means of tappets carried by the crosshead. The number of strokes made by these pumps evidently depends upon the pressure of water in the supply pipe, and also upon the rapidity with which the valves, *V* and *V*, are opened and closed.

In the preceding, I have followed the action of but one underground pump, but, as I have said before, the two are alike in every respect, and both draw their water from and discharge it into the same columns.

From the above remarks, it will be seen that the sole object of these two underground pumps is to raise the drain water from the 2,400 level of the mine to the Sutro Tunnel, a distance of 800 feet. The object of the accumulator, *A*, upon the surface, is to accumulate the water within it, under a pressure great enough to work the pumps, *P*, and the object of the compound steam engine and pumps, *T* (on the surface), is to supply the accumulator with exactly the same amount of water taken from it, to run underground pumps. Furthermore, it will be noticed that the same amount of water which is used to run these pumps, *P*, is returned to reservoir on the surface, from whence it is forced into the accumulator by pumps, *T*, to be used over and over again.

Right here it might be well to mention the fact, that the surface pumps, *T*, were constructed with a capacity great enough for two more pumping engines, similar to those just described (*P*), so that when a depth of 1,000 feet more was reached, this extra set of pumps would be put in at the 3,400 level, and the process go on as before.

The above description, by Mr. Moore, explains the action of the hydraulic pumps on the Comstock. Since it was written the pumps have been running several years, and the springs (marked *S* on the diagram) have been replaced by air chambers, so that the concussion of water lost in discharge, pressure, and return columns, has been overcome by means of air chambers erected on the same station with the pumps. It was found impossible to properly regulate the springs to work as efficiently as the air chambers have done. The population of Virginia City decreased so rapidly that the water company were enabled to supply the Combination Shaft with water to run their pumps. Instead of the accumulator and surface engine being required, they were only kept as a reserve in case of a failure of the water supply. After the shaft had been sunk considerably in depth, two more pumps were added on the 2,600-foot level, and later on two extra additional ones at the 3,000-foot level, which raised 4,000,000 gallons of water daily to the Sutro Tunnel, a direct lift of 2,400 feet of hot water, at a temperature of 140 degrees. In all there were six pumps, which have been running constantly, without a single stop, this last number of years. It is

only in October last that they were shut down, by order from the companies, because deep prospecting was found unprofitable. They are now submerged in several hundred feet of water. The Risdon Iron Works have built several other pumps on this same style, and all have worked successfully. These pumps have lately been introduced in England, at some large collieries there, and are also working satisfactorily.

WEIGHT OF QUARTZ MILLS.

As many miners have no information of the details of weight of the parts of quartz mills, the following statement concerning five, ten, and twenty-stamp gold mills has been obtained from the Joshua Hendy Machine Works, San Francisco. Of course the weights of the ore-feeders and the concentrators depend upon the pattern used, but the figures given will afford a basis upon which miners can estimate what freights have to be paid.

MEMORANDA OF WEIGHTS OF FIVE-STAMP QUARTZ MILL (GOLD).

Rock-breaker	4,500 lbs.
Ore feeder ("Challenge")	750 lbs.
Mortar, for 750-lb. stamps	4,000 lbs.
Dies, 100 lbs. each, five	500 lbs.
Shoes, 110 lbs. each, five	550 lbs.
Stems, 340 lbs. each, five	1,700 lbs.
Bossheads, 200 lbs. each, five	1,000 lbs.
Tappets, 100 lbs. each, five	500 lbs.
Cams, 150 lbs. each, five	750 lbs.
Cam shaft	350 lbs.
Concentrators ("Triumph"), 2,275 lbs. each, two	4,550 lbs.
Clean-up pan	800 lbs.
Revolving barrel	1,200 lbs.
Batea	200 lbs.
Retort	75 lbs.
For pulleys, piping, belting, bolts, etc.	2,400 lbs.
Total	23,825 lbs.

MEMORANDA OF WEIGHTS OF TEN-STAMP GOLD QUARTZ MILL.

Rock breaker	5,200 lbs.
Ore feeder ("Challenge") 750 lbs. each, two	1,500 lbs.
Mortar for 750-lb. stamps, 4,000 lbs. each, two	8,000 lbs.
Dies, 100 lbs. each, ten	1,000 lbs.
Shoes, 110 lbs. each, ten	1,100 lbs.
Stems, 340 lbs. each, ten	3,400 lbs.
Bossheads, 200 lbs. each, ten	2,000 lbs.
Tappets, 100 lbs. each, ten	1,000 lbs.
Cams, 150 lbs. each, ten	1,500 lbs.
Cam-shaft, 13′ 6″x4′ 1″	700 lbs.
Concentrators ("Triumph"), 2,270 lbs. each, three	6,810 lbs.
Clean-up pan	800 lbs.
Revolving barrel	1,200 lbs.
Batea	200 lbs.
Retort	100 lbs.
Pulleys, piping, belting, bolts, etc.	5,300 lbs
Total	39,810 lbs.

MEMORANDA OF WEIGHTS OF TWENTY-STAMP GOLD QUARTZ MILL.

Rock-breaker	10,300 lbs.
Ore-feeder ("Challenge"), 750 lbs. each, four	3,000 lbs.
Mortar for 800-lb. stamps, 4,500 lbs. each, four	18,000 lbs.
Dies for 800-lb. stamps, 125 lbs. each, twenty	2,500 lbs.
Shoes for 800-lb. stamps, 120 lbs. each, twenty	2,400 lbs.
Stems for 800-lb. stamps, 360 lbs. each, twenty	7,200 lbs.
Bossheads for 800-lb. stamps, 210 lbs. each, twenty	4,200 lbs.
Tappets for 800-lb stamps, 110 lbs. each, twenty	2,200 lbs.
Cams for 800-lb. stamps, 165 lbs. each, twenty	3,300 lbs.
Cam shaft	1,700 lbs.
Clean-up pan	1,000 lbs.
Revolving barrel	1,400 lbs.
Batea	200 lbs.
Retort	300 lbs.
For pulleys, belting, piping, bolts, etc.	12,600 lbs.
Total	70,300 lbs.

The Pacific Iron Works of San Francisco also furnish data to this report on both silver and gold mills, as follows:

TEN-STAMP FREE ORE SILVER MILL.

One 4 feet by 12 feet grizzly.
One 8 by 10 Blake crusher.
Two automatic ore feeders.
One 10-stamp battery, 750 to 800 pound stamps.
Four 5-foot combination amalgamating pans.
Two 8-foot settlers.
One 3-foot clean-up pan.
One amalgam safe and strainer.
One quicksilver elevator, with tanks, pipes, etc.
Two traveling crabs for battery and pans.
One 14-inch silver retort.
One melting furnace.
Shafting, pulleys, boxes, etc., for mill.
Belting for mill.
Pipes and fittings complete.
One Duncan concentrator for saving quicksilver and amalgam.
Weight of the above, 87,000 pounds.

Power required:
One 50-horse power engine.
One 50-horse power boiler.
One 50-horse power feed-water heater.
One No. 3 steam pump.
Steam and water connections.
Weight of the above, 24,500 pounds.
Total weight of the above, 111,500 pounds.

TWENTY-STAMP FREE ORE SILVER MILL.

One 4 feet by 12 feet grizzly.
One 8 by 10 Blake crusher.
Four automatic ore feeders.
Two 10-stamp batteries.
Eight 5-foot combination pans.
Four 8-foot settlers.
One 4-foot clean-up pan.
One quicksilver elevator, with tanks, pipes, etc.
Three traveling crabs and track for batteries and pans.
Two amalgam safes and strainers.
Two 14-inch silver retorts.
One melting furnace.
Shafting, pulleys, boxes, etc., for entire mill.
Belting for entire mill.
Pipes and fittings for mill.
One Duncan concentrator, for saving amalgam and quicksilver.
Weight of the above, 180,000 pounds.

Power required:
One 100-horse power engine.
Two 50-horse power boilers.
One 80-horse power feed water heater.

One No. 4 steam feed pump.
Steam and water connections.
Weight of the above, 50,000 pounds.
Total weight of the above, 230,000 pounds.

Grizzly, 4 feet by 12 feet, weighs about 2,000 pounds.
8 by 10 Blake crusher weighs about 8,000 pounds.
Automatic feeder weighs about 700 pounds.
Battery, ten stamps, weighs about 27,000 pounds.
5-foot pan, combination, weighs about 6,200 pounds.
8-foot settler weighs about 6,000 pounds.

TEN-STAMP GOLD MILL.

One grizzly, 4 feet by 10 feet.
One 8 by 10 Blake crusher.
Two automatic ore feeders.
One 10-stamp battery, 750 pound to 800 pound stamps.
One traveling crab for battery.
Sixty square feet of silver-plated copper plate, No. 14 gauge, plated 1 ounce of silver to the square foot.
Shafting for mill.
Battery, pipes, and fittings.
Belting for mill.
One gold retort.
Weight of the above, 37,500 pounds.
Power required:
One 25-horse power engine.
One 30-horse power boiler.
One 20-horse power feed water heater.
One No. 2 steam pump.
Steam and water connections.
Weight of the above, 10,500 pounds.
Total weight of the above, 48,000 pounds.

TWENTY-STAMP GOLD MILL.

One grizzly, 4 feet by 12 feet.
One 8 by 10 Blake crusher.
Four automatic ore feeders.
Two 10-stamp batteries, 750 pound to 800 pound stamps.
Two traveling crabs for batteries.
One hundred and twenty square feet silver-plated copper plates, No. 14 gauge, plated 1 ounce of silver to the square foot.
Shafting for mill.
Battery pipes and fittings.
Belting for mill.
One gold retort.
Weight of the above, 72,000 pounds.
Power required:
One 50-horse power engine.
One 50-horse power boiler.
One 50-horse power feed water heater.
One No. 3 steam pump.
Steam and water connections.
Weight of the above, 24,500 pounds.
Total weight of the above, 96,500 pounds.

TWENTY-STAMP GOLD MILL.

Many communications having been received by the State Mineralogist for component parts of gold mills, he deemed it advisable to publish in his report the following specifications, kindly furnished to Trustee W. S. Keyes, E.M., by J. Hamilton:

SPECIFICATIONS OF TWENTY-STAMP GOLD QUARTZ MILL FOR THE BUCHANAN MINE, TUOLUMNE COUNTY, CALIFORNIA.

One (1) *Grizzly*, to be made of ¾-inch by 2½-inch wrought iron, 12 feet long, 4 feet wide; spaced 2 inches between the bars, and secured by three ¾-inch bolts, and cast-iron thimbles and washers; also end bars.

Rock Breaker.—One Blake crusher, fitted with two flywheels, 4 feet in diameter, and one (1) pulley, 30 inches in diameter, and 12-inch face crank-shaft, to have out-board bearings; holding-down bolts for each, to be long enough for 14-inch timbers; all caps for boxes to be fitted to use zinc oil cups, and "Albany" lubricating compound.

Battery.—Four (4) single discharge gold mortars, each weighing about 5,000 pounds; the bottoms to be 6½ inches thick; well planed; the screw frame bearings to be planed also; the bases to be 26 inches wide, 3 inches thick, and cored for eight (8) mortar bolts 1½ inches in diameter; the feed mouth to be 26 inches long and 3½ inches wide, at the smallest part; the mortars to be well finished, and to be 56 inches long, and about 52 inches high.

Mortar Bolts.—Thirty-two (32) mortar bolts, 1½ inches in diameter, and 36 inches long; nuts on both ends, and thirty-two (32) 4-inch square countersunk washers for the lower ends; one (1) wrought-iron wrench; jaw designed for the nuts of mortar bolts; arm to be 6 feet long, slightly curved, made of 1-inch by 2½-inch iron.

Stamp Dies.—Stamp dies, 7 inches deep, 8½ inches in diameter, with square bases, having beveled corners, and all made to properly fit the mortars, and to be cast of the best car-wheel iron; stamps to weigh 850 pounds each.

Shoes.—Twenty (20) stamp shoes, 8½ inches in diameter, 7½ inches long; to be cast of the best car-wheel iron.

Heads.—Twenty (20) stamp heads, 8½ inches in diameter, 18 inches long; keyholes to be 1⅜ inches by 3 inches; one (1) key for driving out shoes and stems, and to be made as may be directed.

Tappets.—Twenty (20) double-faced gib tappets, made of the best steel faces, 9 inches in diameter; tappets to be 12 inches long; bands or flanges turned, and each to have gibs and three (3) steel keys, and all to be marked; keys to be boxed for shipment.

Cams.—Twenty (20) double-armed cams, made of best steel; ten (10) to be right, and ten (10) to be left-handed; hubs on one side, and to be strongly banded with ¾-inch by 2-inch wrought-iron bands, well shrunk on; the faces of the cams to be well smoothed, and to be fitted to 5½-inch cam shafts, and to be properly marked.

Feeders.—Four (4) Hendy Challenge ore feeders, complete with all latest improvements; also, twenty (20) steel keys for same, to be marked and fitted, and properly boxed for shipment; the cams to be about 32 inches long, with 2½-inch face, and struck to give an 8½-inch drop if required.

Corner Boxes.—Six (6) corner boxes, for 5½-inch cam shafts; cored for 1-inch bolts; backs to be planed true, and bearings to have a strip running lengthwise, and the balance of the bearings to be well babbitted and bored; the ends to be faced; the cap to be solid, bored, but not babbitted, unless required, and bored with three (3) ⅜-inch holes each, for using "Albany" compound.

Cam Shafts.—Two (2) cam shafts, 5½ inches in diameter, and 14 feet 6 inches long, and key-seated between bearings.

Jack Shafts.—Four (4) jack shafts to be 3 inches in diameter and 59 inches long, with eight (8) bearings for same, and to be made of cast-iron.

Stems.—Twenty (20) stamp stems 3¼ inches in diameter, 14 feet long; turned and tapered off both ends for heads; made of rolled iron.

Latch-sockets.—Twenty (20) open latch-sockets; all to be well lined with heavy leather.

Guides.—Four (4) complete sets of best white oak guides. The lower guides to be 16 inches wide and 4 inches thick, and the upper to be 14 inches wide and 4 inches thick; bored for 3¼-inch stamp stems, and to be 10 inches between centers; all to be 60 inches long.

Cam-shaft Pulleys.—Two (2) wood pulleys, 72 inches in diameter, with 16-inch faces and 6-inch thickness of wood between the flanges, and to be made of the best kiln-dried sugar pine; to be turned and well bolted to 40-inch diameter cast-iron sleeves; flanges for 5½-inch cam shaft; the flanges to be faced.

All of the keys for this mill to be made of the best steel.

Overhead Crabs.—One (1) crab for battery having flanged wheels 7 inches in diameter and 2-foot face; the axles to be 1½ inches square and long enough to set the wheels 10 inches between the flanges; the boxes to be 1¼ inches thick, and all made of the best wrought iron.

Piping, etc.—All piping, hose, valves, bibs, cocks, ells, tees, unions, etc., to be furnished as per detailed bill. All necessary bolts, belts, nuts, and washers, also copper plate for battery and aprons, to be furnished of proper weight, and as shown on drawings, ⅛-inch thick, not plated; also, silver-plated copper plate, 20 inches wide and 20 feet long.

Belting—One (1) main driving belt, to be about 55 feet long, 20 inches wide, and made of the best 5-ply rubber of the "Boston Belting and Packing Co.'s" manufacture, patent stretched.

Battery Belts.—One hundred and ninety (190) feet of the best 5-ply rubber, 16 inches wide.

Rockbreaker Belt—Ninety (90) feet of 4-ply rubber, 12 inches wide.

Boxes for Shafting.—All boxes to be planed on the bottom and faced on the ends, and to be well babbitted, and the caps to be bored with ⅜-inch holes, for Tatum & Bowen's lubricating compound. Two (2) steel collars and set-screws for each.

Shafting and Pulleys.—One (1) main battery line shaft to be made in two lengths, 4 inches in diameter, 20 feet long, and 3½ inches diameter, 20 feet long, coupled together with solid coupling. One (1) countershaft for driving rock breaker, 3 inches diameter, 20 feet long; both shafts fitted with all necessary bearing boxes, and holding down bolts for 14-inch timbers.

Pulleys.—One (1) main driving pulley to be fitted to engine crank shaft at mine, to be 48 inches diameter, 21-inch face.

One (1) pulley for main battery line shaft, to be 72 inches diameter, 21-inch face, 4-inch gauge.

One (1) pulley to drive crusher countershaft, 40 inches diameter, 12½-inch face, 4-inch gauge.

One (1) pulley to drive battery, 34 inches diameter, 16½-inch face, 3½-inch gauge.

One (1) pulley to drive crusher, about 40 inches diameter, 12½-inch face, 3-inch gauge.

One (1) pulley on crusher countershaft, 26 inches diameter, 12½-inch face, 3-inch gauge.

Tighteners.—Two (2) battery tighteners, 16 inches diameter, 20-inch face, with racks, pinions, frames, hand-wheels, pawls, and pawl plates, complete for stopping and starting the batteries.

One (1) rock breaker tightener complete, as above specified, for stopping or starting the crusher.

All necessary bolts for batteries and building, and all necessary belt rivets for securing the belts. All belting used in this mill to be of Boston Belting Co.'s manufacture, best quality and patent stretched.

All castings to be made of good material, smooth and free from blow-holes or other imperfections. All keys to be made to fit and properly marked.

Mortars are to be cast from selected patterns or drawings, which will be furnished.

Should anything be lacking to complete this mill which has not been specified, it must be supplied the same as if fully mentioned.

Everything to be delivered on the ground (at company's expense), and timbers to be cut according to plans to be supplied.

Note.—The company already had an engine and boiler. The building, also, over the mill was built by the company. The cost of the above material was $5,985, and of the labor, $2,300. Save a slight change in the tappets, the work was satisfactorily done, and the mill crushed over two tons per stamp, of hard quartz, every 24 hours.

The total cost of grading, building, machinery, etc., was a little short of $15,000.

CONCENTRATION OF GOLD AND SILVER ORES ON THE PACIFIC COAST.

(By J. M. Adams, E.M.)

This article is based entirely upon the practical experience of the writer, who, since first becoming connected with the mining interest, has ever sought to draw attention to the great importance of a correct system of concentration.

In 1867 he came to California, en route to Silver City, Idaho, where he was engaged for some time in mining and milling the ores of gold and silver.

As a part of his studies in the Mining School, of which he is a graduate, he labored over Rittinger's Aufbereitenskunde, and obtained from it a fair book knowledge of the dressing and concentration of ores, as practiced in Europe. But the conditions are so different in this country, labor is so much higher, etc., that he has found the appliances advocated by Rittinger of but little benefit, as for example:

Mr. Liebenan, a bright, intelligent, and industrious young German, who had graduated from Freiburg, consumed a large part of the year 1867 endeavoring to concentrate economically with shaking tables, etc., the ores of Flint District, about eight miles from Silver City, Idaho.

The mineral present at the ores was largely tetrahedrite, or gray copper ore, containing a high percentage of silver, the gangue being a hard white quartz. Mr. Liebenan, however, failed, partly because the German method required so much labor, which was very high in Idaho; still he obtained a fair percentage of the mineral in high grade concentrations, and would probably have made a success, if he could have used the perfect automatic concentrators now in use in the mining sections of the United States. As it was, Liebenan failed, and drifted away to other fields, finally dying, poor fellow, in the prime of life, in Venezuela.

In one of the mills at Silver City, of which the writer had charge, he attempted to save part of the loss in the tailings with Hungerford concentrators and Evans' corrugated riffles, using them below the agitators, but he found the uneven discharge and varying proportion of sand and water so injurious, that satisfactory results could not be obtained; furthermore, neither were very effective appliances for saving sulphurets.

He used siphons and other means to draw from the agitators, in the endeavor to obtain uniform supply for the concentrators, but all that was saved was a little quicksilver and amalgam, not enough to pay for the wear and tear of the Hungerfords, which are similar to the Hendy concentrators, which are described on another page. The use of sluices with blankets also proved unsatisfactory.

In 1867 the writer stopped for a day at Grass Valley, where he found at the Eureka Mine, in successful operation, a "wonderful and secret process" for extracting the gold from the sulphurets, called "chlorination."

Sluices were being used below the mill to save the sulphurets. Concentration of ores is simply the separation of the heavy from the light, and is performed sometimes on dry ore, but generally water is used, especially in California, where it is practiced principally on the ores of gold and silver, which are either native or associated with, or part of various metalliferous minerals; the gold and silver, as well as the minerals, being much heavier than the gangue or vein matter in which they occur.

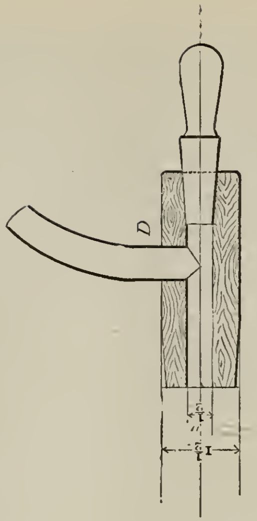
They are freed to a large extent from the gangue by crushing or pulverizing to a proper degree of fineness, and according, as the concentrating work is more or less perfect, the separation is made of the heavy or valuable part of the ore from the gangue. Occasionally the lightest—or finest—part of the crushed ore is very rich, and is worth saving by itself.

In dry concentration this is the dust, and is separated and saved if of sufficient value.

In wet concentration this light portion is the slime, and if rich enough to be saved the pulp is passed through a pointed box (as per cut and description below). The slimes pass off from the top, to be settled and saved, the balance discharging from the bottom to the concentrator, for separation and saving of the mineral.

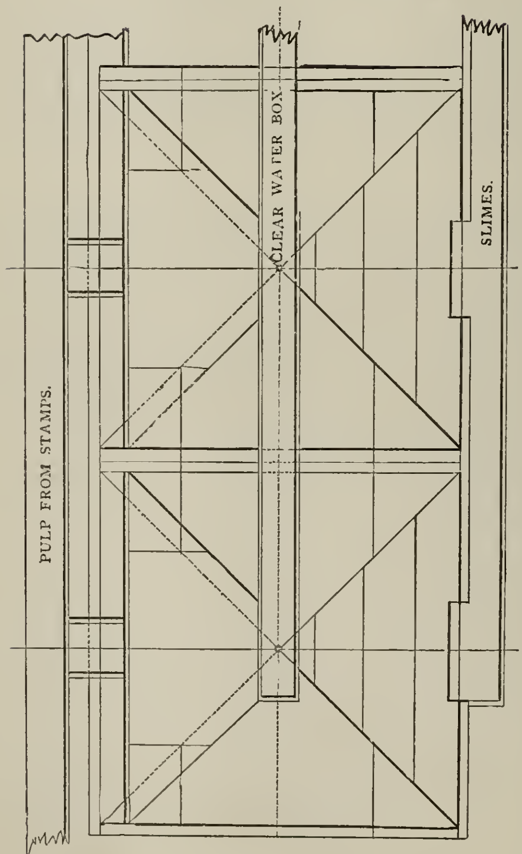
In some cases it is preferable to put the pointed box below the concentrator, and thus separate from the tailings and save the rich slimes. As a rule, however, most of the money in the slimes exists as finely divided sulphurets, which are caught and saved with the balance of the sulphurets by the best concentrators, so that there then is only an occasional ore whose slimes need segregation and saving.

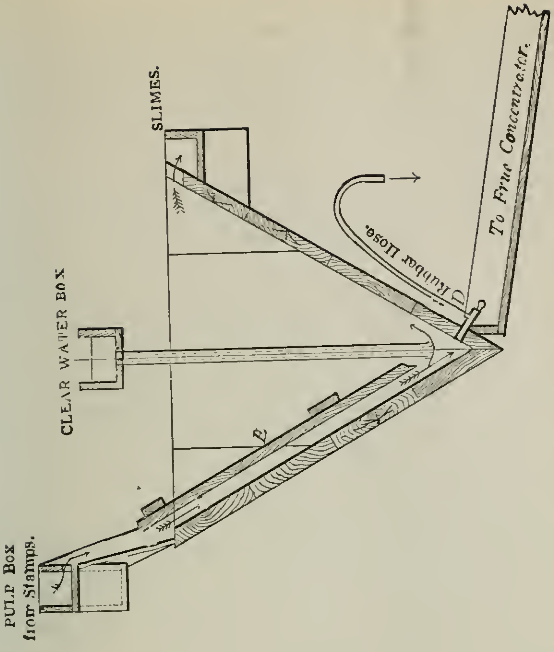
I have, however, deemed it best to give the following description and cut of the pointed box:

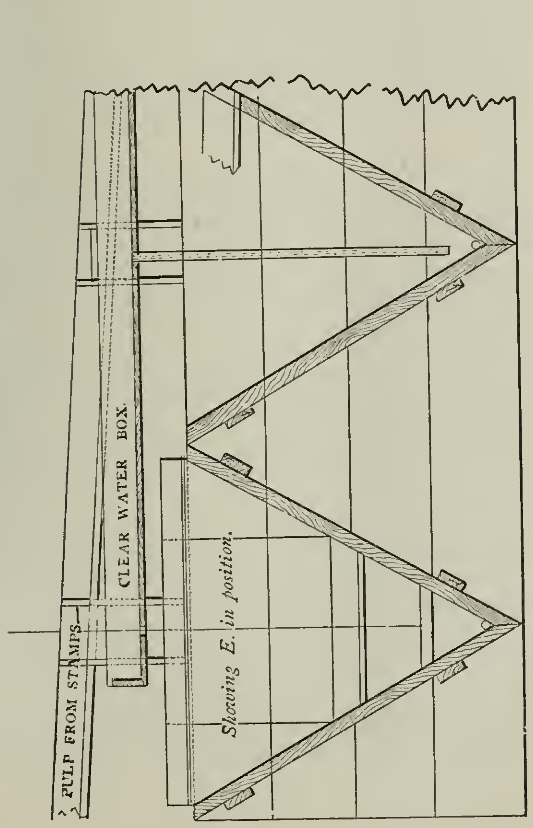


POINT BOX.

Scale, $\frac{1}{2}'' = 1'$




SLIMES.
CLEAR WATER BOX
PULP Box
from Stamps.
E
Rubber Hose.
D
To Frue Concentrator.


PULP FROM STAMPS
CLEAR WATER BOX.
Showing E. in position.

Several forms are in use. Their dimensions vary according to the duty required. In some cases it is desired to save and settle together all the pulp, including the slimes, when there is too much water present for subsequent concentration. In such event the pointed box should be about 6 feet deep, and 3 feet by 7 feet at the top, the longest sides sloping till they meet at the bottom.

Such a box will settle and save about six tons of ore in twenty-four hours, discharging it automatically and continuously from the bottom by a siphon hose, with the proper amount of water for subsequent concentration.

This form is used when the tailings from pan amalgamation are to be concentrated, after leaving the settlers and agitators, for they contain a large excess of water, which must be gotten rid of, so that the tailings are of the proper consistency for concentration.

The accompanying cut shows a form of point box used in cases where the slimes are to be separated from the pulp and saved. Each box is 40 inches square at the top, and 40 inches deep, coming to a point at the bottom; and one box will handle from 6 to 10 tons of pulp in twenty-four hours, making a good separation.

The pulp from the battery, entering the box at the top, is confined by partition *E*, until it passes into the box proper, near its bottom. Clear water is conveyed from above through a half-inch pipe, which delivers it into the box at the bottom. Care must be taken that this pipe is kept full, so that no air bubbles are carried through it, as they create agitation, and cause sand, etc., to pass off with the slimes.

The amount of clear water needed varies, so it is a good plan to have a cock in the pipe just below the clear water box, or else partially close, with a wooden plug, the opening of the pipe in the clear water box. At D is a hollow plug, and to it is attached a piece of hose, which is used as a siphon, so that the pressure is lessened and too violent discharge of the pulp is prevented.

Without the siphon hose, $\frac{2}{8}$ inches opening would not be too small, while with it $\frac{3}{8}$ inches opening is about right, and the end of the hose is plugged accordingly. Inasmuch as foreign coarse material occasionally gets into the box (prevented as much as possible by a screen over the top), it is advisable to use in place of the hollow wooden plug shown, a $1\frac{1}{2}$-inch iron tee with one end plugged, and with $\frac{3}{4}$ inch side outlet, attaching the siphon hose by nipple.

Thirty-five years ago, concentration in California consisted simply in saving the placer gold, and the appliances used were the rocker and sluice. Various grades were given to the sluice; its bottom was formed in various ways, some using plain riffle bars, some preferring blocks of wood sawed across the grain; others liked boards, full of round holes, undercurrent riffles, etc. Sometimes quicksilver was used to catch the gold; sometimes none was used.

When gold was discovered in quartz in California, and reduction works for the same were to be constructed, Californians knew nothing of the required means, and had to adopt the old square wooden stem Cornish stamp, the arrastra, etc., but with our ingenuity, native to Americans, improvements were rapidly made, and to-day American (United States) machinery for mining and reduction of gold and silver ores is the best in the world.

The old fashioned stamp was replaced by the round iron stemmed stamp, revolving as it is lifted by the cam, and with cams, tappets, shoes, and dies of cast-steel, the wear has been reduced to a minimum, and the

present standard American stamp mill is a very different crushing appliance from the clumsy stamps first used by us.

Most of the quartz veins worked in early days were either much decomposed on the surface, or were clean quartz containing the bright yellow gold. As depth, however, was attained, the decomposed ores changed, and sulphurets of iron and copper, with galena, blende, and other minerals, were found. The ore did not yield as much of its gold as the surface ore; there was some gold in the tailings, and further examinations showed that a large part of the loss was in the sulphurets, hence we began to realize that there was money in the sulphurets, and two problems arose:

First—How to save the sulphurets.

Second—How to realize the money contained in them after they were saved.

In regard to the second problem it was soon known, that if rich enough they could be sold to parties who would send them to —— ——, or other smelting works in Europe, while in some cases quite a proportion of the gold could be saved by thorough amalgamation in pans or barrels, and about 1867 it was proved that a high percentage of the gold could be profitably extracted from the sulphurets by roasting and chlorination.

As regards the first problem, "How to save these gold-bearing sulphurets," here the necessity of concentration became apparent, as the only economical method was by taking advantage of their greater weight and separating them accordingly.

Labor being very high, automatic concentrators became a desideratum, stimulating the inventive faculties of many who were engaged in mining. Various machines were devised and tested; most of them proved to be of little value, and the appliances in general use for saving sulphurets in California in 1875 were few in number, being as follows:

The sluice with blankets or burlaps.

The sluice with riffles and the buddle.

The raising gate.

The Hendy concentrator.

The grade of the sluice, using blankets or burlaps, was generally about ½ inch to the foot. A double set was used; the blankets or burlaps in one set being taken up and washed, while the other set was in use. By very frequent washings the sulphurets were obtained fairly clean, but this took so much labor that they were seldom washed, and the ordinary product contained much sand, and the sulphurets contained were coarse, the finer sulphurets passing off, although nearly equal in quantity and frequently much richer than the coarse sulphurets.

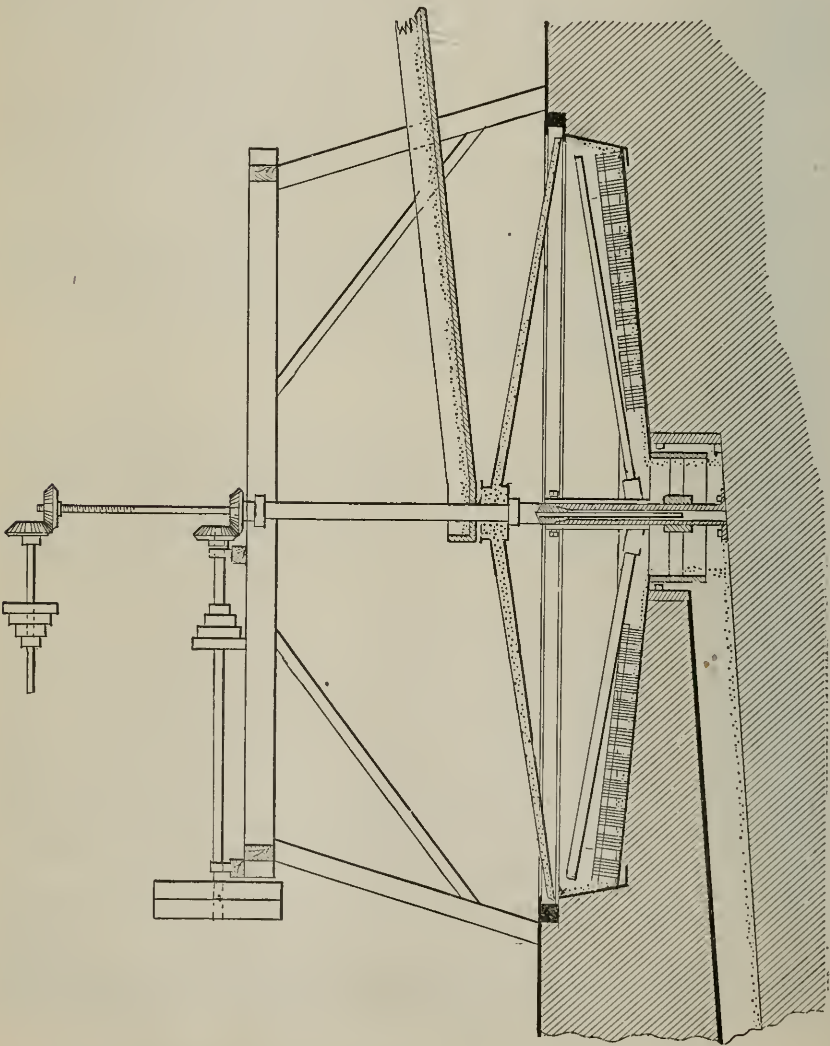
The grade of the sluice with riffles was about ¾ inch to the foot, and was generally of the following type: Two sets are used; each riffle is formed by a half-inch strip of wood, fitting across the sluice, and about ten feet from the next riffle. At stated periods, according to the amount to be collected (varying in different ores), another strip is placed on top of the previous one, and this is continued until the sluice is nearly full at each riffle, when the tailings from the mill are turned into the other set of sluices for similar treatment, and the material accumulated in the first set of sluices is collected, and further concentrated in a buddle, of which there are several styles.

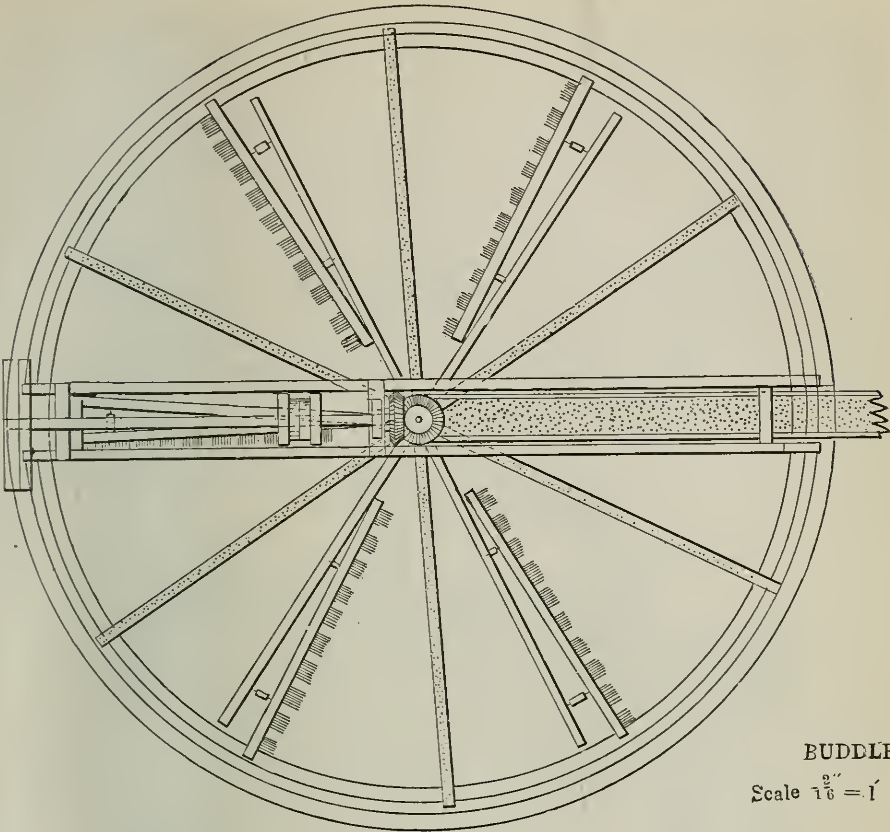
The accompanying cut shows one used frequently, and may be described briefly, as follows: It is circular, with concave bottom, and the discharge for the tailings is in the center, where there is a hollow iron cylinder, shown in the cut, with its top or rim even with the bottom of the buddle. In this position everything will flow out of the buddle, but this ring or

cylinder is attached to an upright spindle and by the gear at the top is gradually raised, retaining in the buddle the sulphurets as they accumulate, and constantly raising the discharge of the tailings; the arms, also, from which the brushes hang, are gradually raised at the same time by the mechanism.

The material to be buddled is delivered from above the center through six pipes at the periphery of the buddle. Very little water is used, and there is no agitation except that made by the brushes, which are constantly moving around the circle, resting on the pulp, and being dragged around by the arms.

By means of the step pulleys above, the gradual raising of the discharge cylinder and of the brushes are regulated as required for the material operated on. When the buddle is full of sulphurets, it is stopped and cleaned out.



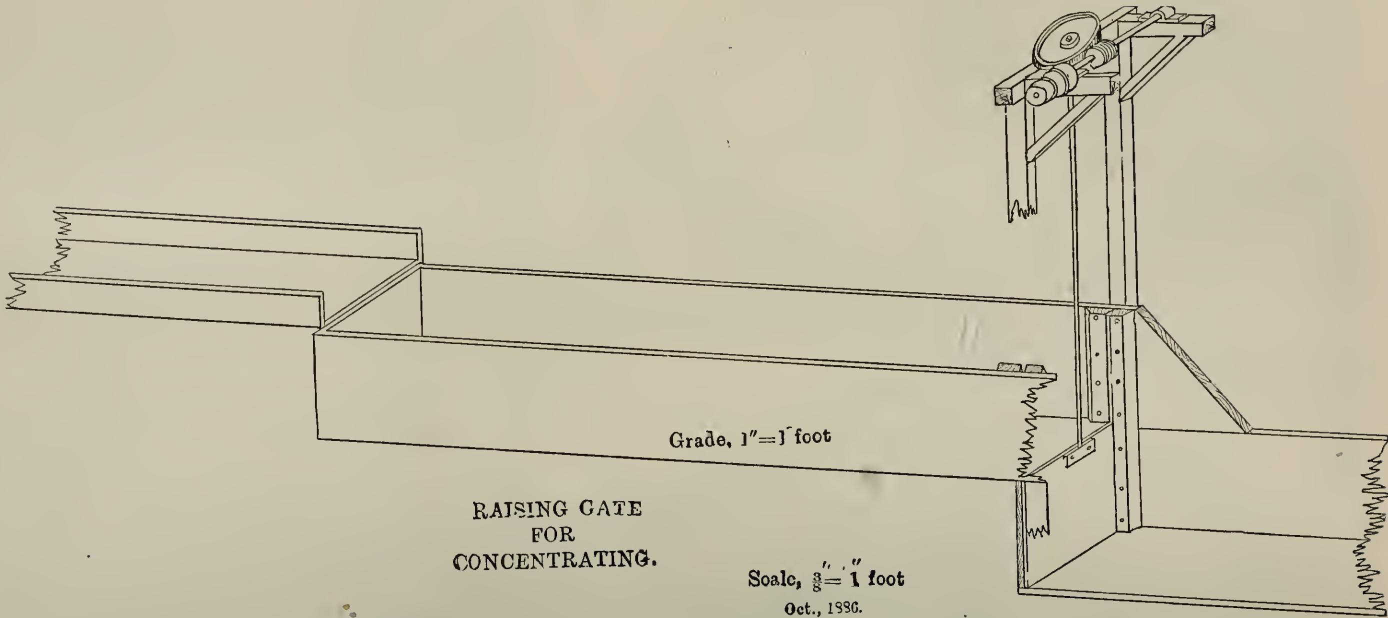


BUDDLE

Scale $\frac{2''}{16} = 1'$

This system of sluice with riffle and buddle does very fair work if carefully attended to, but requires a large amount of labor, and does not save the *finest* sulphurets.

The raising gate may perhaps be best described as the sluice with riffles, improved by having the riffle raised gradually by machinery. The accompanying cut shows the raising gate *down, or open*; by the gear above it is gradually raised, the speed being changed at will by the step pulley.



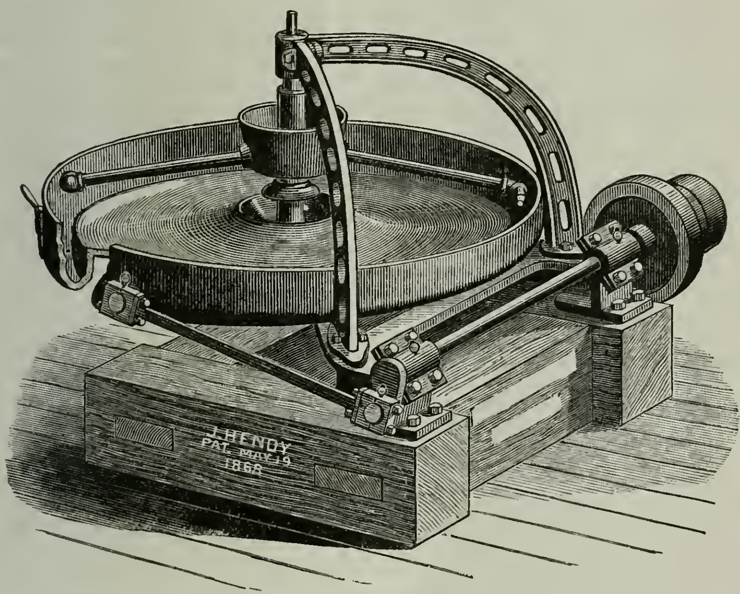
RAISING GATE
FOR
CONCENTRATING.

Scale, $\frac{3}{8}''$ = 1 foot
Oct., 1886.

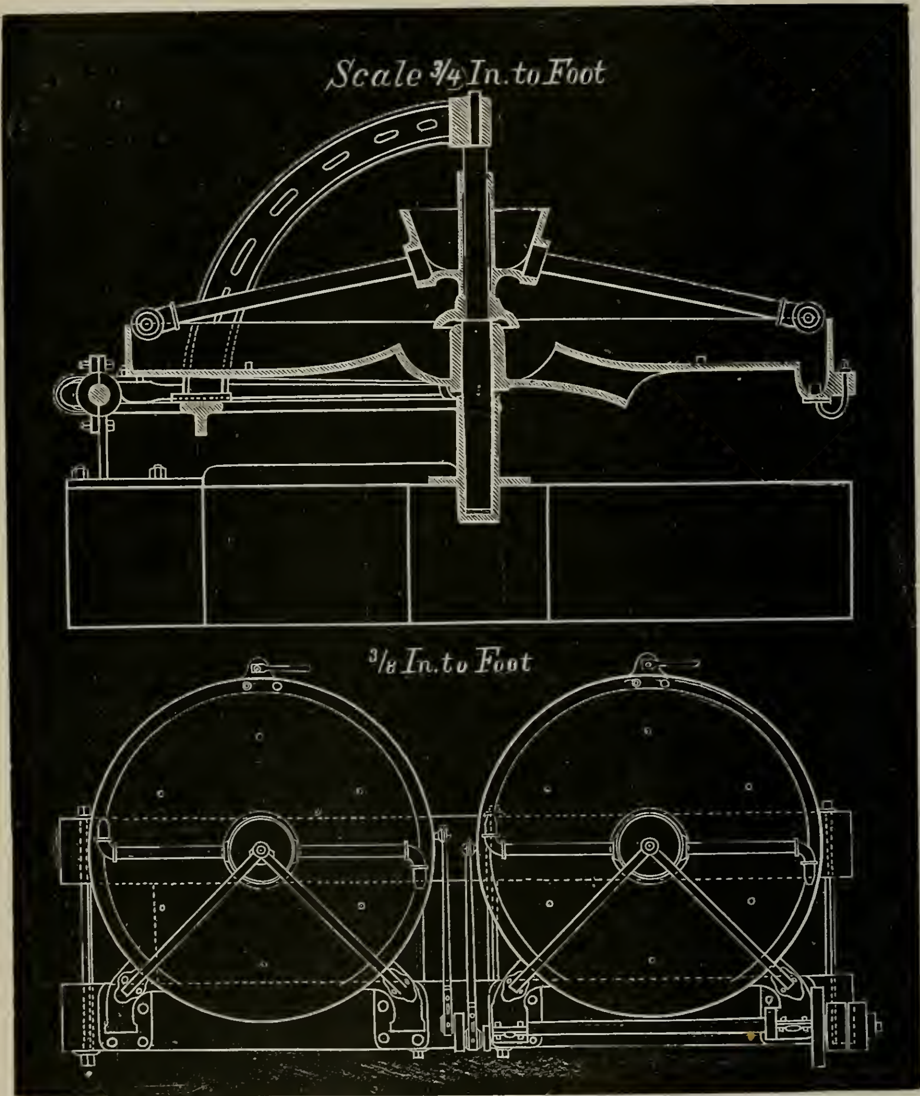
It saves some labor, but its work is about the same as the sluice with riffles, described above.

The Hendy concentrator was used very extensively for several years. The cut shows it to be circular, and of iron; the bottom is slightly convex, and at its periphery is a circular or annular trough, deeper than the main bottom. By the crank shaft it is given a short, quick, vibrating motion, horizontally, turning on its center as a pivot. The pulp is delivered into the bowl above the center, and is conveyed by two arms or pieces of pipe, and delivered on the concentrator at its periphery.

A depth of about 3 inches of material is kept in the concentrator; the heaviest settling to the bottom, and being moved gradually by centrifugal force towards the outside of the pan, where it collects in the annular trough, and discharges from a spout. The concentrations, still containing much sand, are passed through a third machine, and reasonably clean sulphurets obtained. The tailings pass off at the center of the machine, through the bottom.



Hendy Concentrator.



Hendy Concentrator.

At the Keystone Mill of forty stamps the pulp is passed through these concentrators, and their tailings pass over sluices with riffles.

In 1875, the writer, with his partner, commenced the arduous task of convincing the mining men of the coast that there was a heavy loss passing away from all the concentrating appliances in use, and that even a perfect concentrator needed proper conditions and proper care to secure its most efficient work. In most cases it was difficult to convince parties that their loss was really so great, and frequently we would be told that if a concentrator was good for anything, it should run itself and need no attention whatever.

The concentrator advocated by the writer as embodying the most correct principle in a good mechanical appliance (subsequently improved and perfected), was the Frue vanner, or ore concentrator; and after three years' constant work, and an expenditure of $30,000, success was attained, and the mining public were largely convinced of the importance of proper concentration of the gold and silver ores of the Pacific Coast.

The word "silver" is used because many of the sulphurets contain a large proportion of silver as well as gold. In the vicinity of Nevada City the production of sulphurets was more than doubled by using the vanners, and similar success attended their introduction and use elsewhere. Its success stimulated others to invent concentrators, so that many new concentrators have been brought before the public, many of them possessing merit, and almost all of them claiming superiority over the vanner.

Nevertheless, the sales of the vanner increase every year, and up to date amount to nearly $1,000,000.

The attention of the public is being drawn more and more every year to the importance and benefit of concentration, and even the low grade silver and gold ores of the Comstock Vein (Virginia City, Nevada), are being successfully and economically concentrated. These ores yielded no profit under the old method of amalgamation.

In former times the necessity of sizing even finely crushed ores was strongly insisted on to properly prepare the ore for concentration, but sizing is rarely found advisable with the concentrators now in use.

In some of the mining districts of this State the ore is very heavy with sulphurets, containing twenty per cent and over. Much of this can be separated by coarse crushing with rolls, etc., and jigging, and this method of treatment is advisable, as there is thus avoided a heavy loss of sulphurets in slime, which would occur if the original ore was finely crushed at first. The tailings from the jigs will still contain much sulphurets, locked up in the gangue, and should be finely crushed and passed over the vanner or some other concentrator.

Occasionally an ore is found in which the silver exists partly as chloride and partly as refractory sulphurets. Formerly such an ore was crushed dry, roasted, chloridized, and amalgamated, but even $30 ore would yield scarcely any profit, and the reduction works were very expensive.

For several years the writer contended that the proper method of treating such ore was by concentration first, and amalgamation without roasting of the tailings from the concentrators. In this manner the expensive dry crushing is replaced by wet crushing, which also doubles the capacity of the mill. The refractory part of the ore is saved by itself in such small compass that it can be either sold or shipped to smelters, or treated at the mill with small expense. The tailings from the concentrators do not need roasting, so that this great expense is saved, as well as the cost of the furnaces.

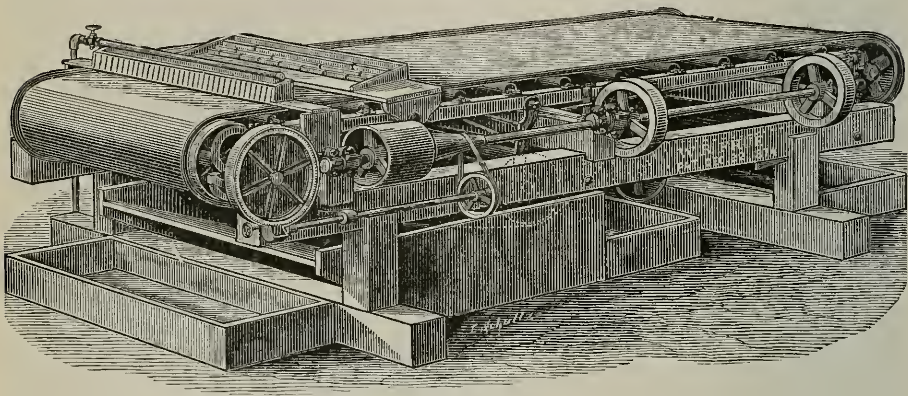
In some localities, ore worth only $6 a ton, can be made to pay by this method, while $30 ore would not pay by the old method of dry crushing, chloridizing, etc.

It is very important that the concentration is made before the amalgamation, for several reasons. The tailings from the concentrator contain no base mineral to trouble amalgamation or cause loss of quicksilver, and the Boss continuous process of pan amalgamation can be used with advantage and economy. If amalgamation should be used before concentration, the sulphurets are ground, and a large part is thereby made so fine that it cannot be saved on any concentrator; too much water, also, is with

the tailings, and there is an uneven discharge from the settlers and agitators.

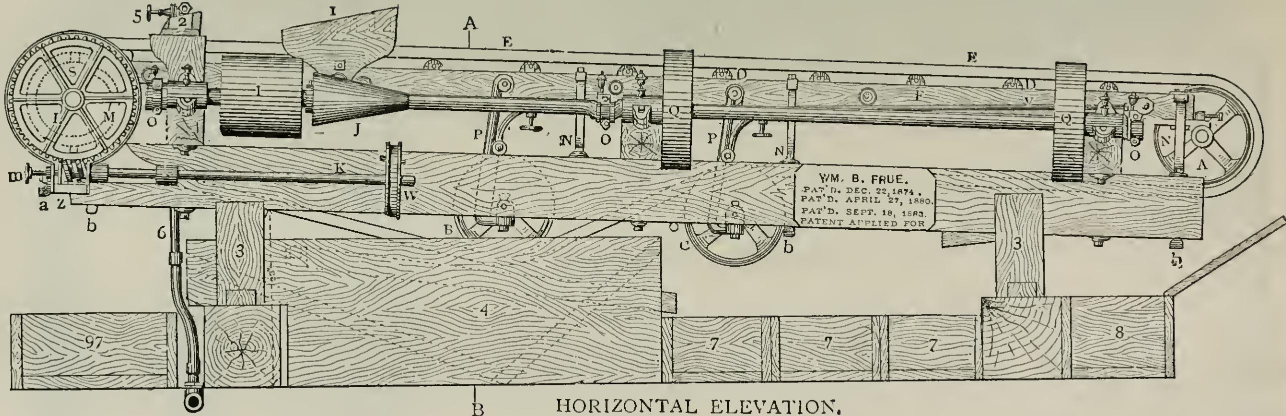
After advocating this method for several years, the writer at last succeeded in having it adopted five years ago by Mr. Randolph, acting for Mr. Alexander R. Shepherd, in the mines of Batopilas (Chihuahua, Mexico), and it is in successful operation there to-day. It is now used also at several mines in the United States.

The Frue vanner is familiar to thousands of mining men. The accompanying cut shows it in perspective, as manufactured several years ago.



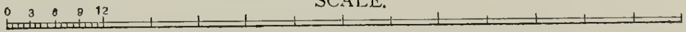
Frue Concentrator.

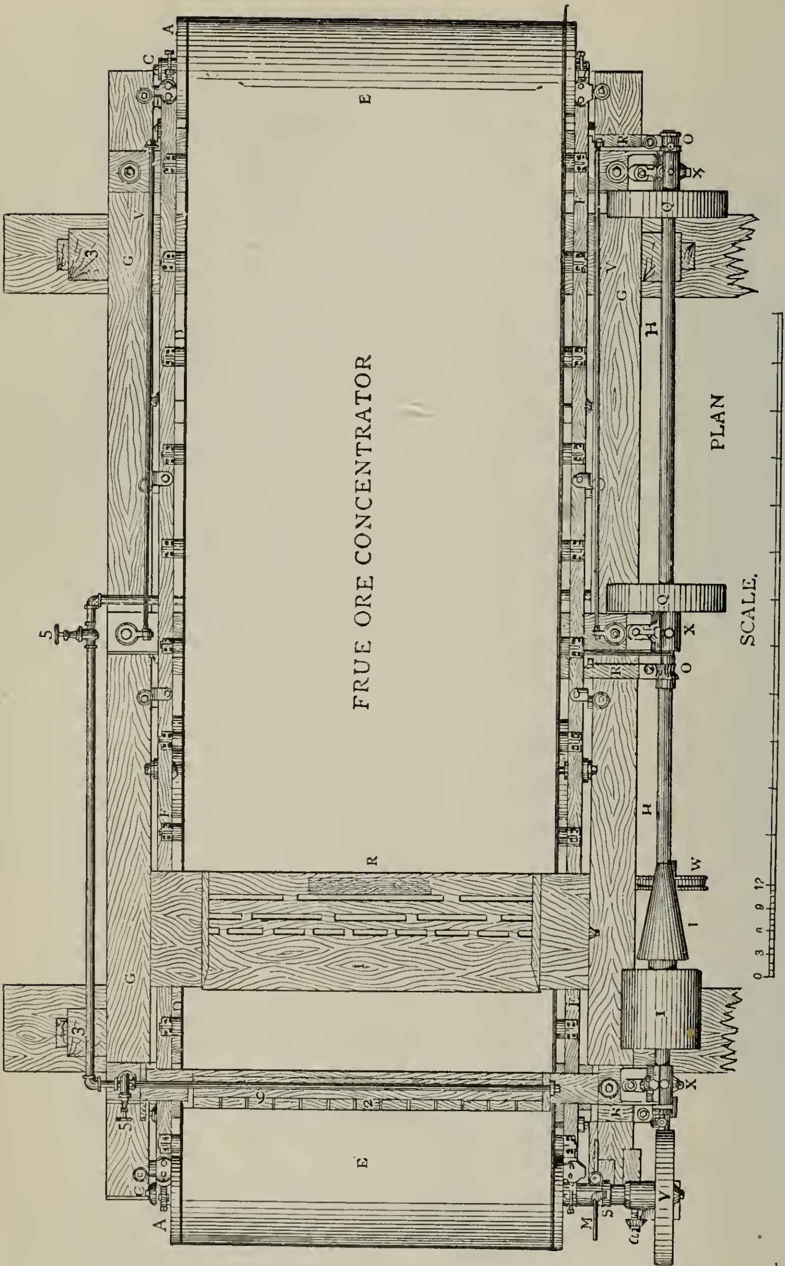
Since then many modifications and improvements have been made, but it is in the main as represented, and consists of an endless traveling rubber belt, with raised sides, moving slowly up hill, forming an inclined table (about $\frac{1}{4}$ inch to the foot being the grade, subject to change according to the ore), and having a short lateral motion of 1 inch, given by a crank shaft running from 180 to 200 revolutions a minute.

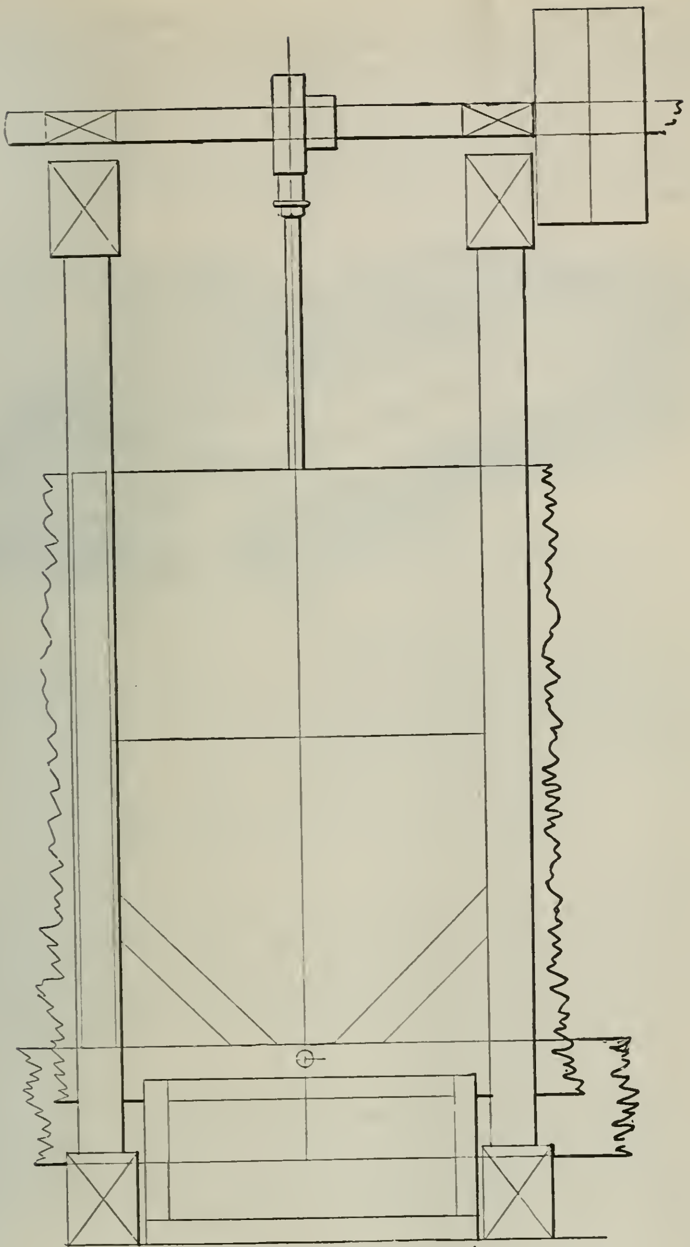


HORIZONTAL ELEVATION.

SCALE.



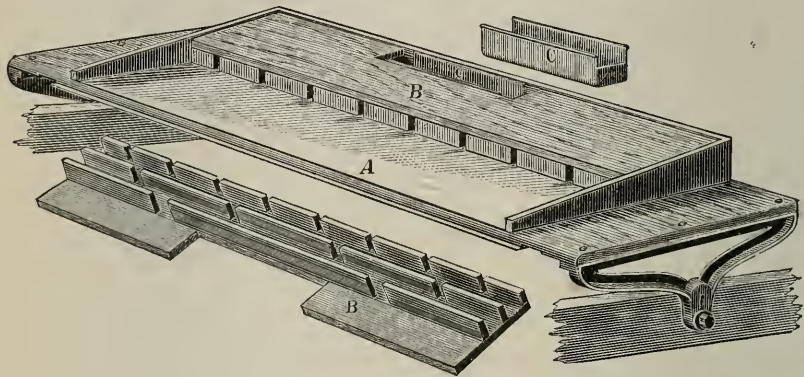

FRUE ORE CONCENTRATOR
PLAN
SCALE.
0 3 6 9 12



JIG

SCALE $\frac{3}{4}'' = 1'$

It can be further understood by the cut of the working drawing, which shows most of the improvements, except the present form of the ore spreader, which is as per cut below, and was devised, so that for gold ores, a silver-plated copper plate could be placed over the entire surface of the spreader, the top board *B*, with blocks attached being put on the plate; also the copper well *C*, in which is caught quicksilver which may escape from the main plate above; when the plate is to be cleaned, the top board and blocks are removed; this is only done occasionally.



FRUE ORE SPREADER.

The ore with water is delivered on the belt by means of the spreader No. 1, in working drawing, which shakes with the table, and distributes the pulp uniformly across the belt. A small amount of clean water is distributed by No. 2, which is a wooden trough in which is a perforated pipe. A depth of three-eighths to one-half inch of sand and water is constantly kept on the table. The main shaft, *H*, should be given the proper speed for each kind of ore, and once established, it should be kept uniform; this speed will be between 180 and 200 revolutions of the crank shaft per minute, with one inch throw.

The up-hill travel or progressive motion varies from 3 feet to 12 feet a minute, according to the ore, and the grade or inclination of the *table* is from 3 inches to 6 inches in 12 feet, varying with the ore. The inclination can be changed at will, by wedges at the foot of the machine. The motion, the water used, the grade, and the up-hill travel should be regulated for every ore individually, but once established no further trouble will be experienced in the manipulation.

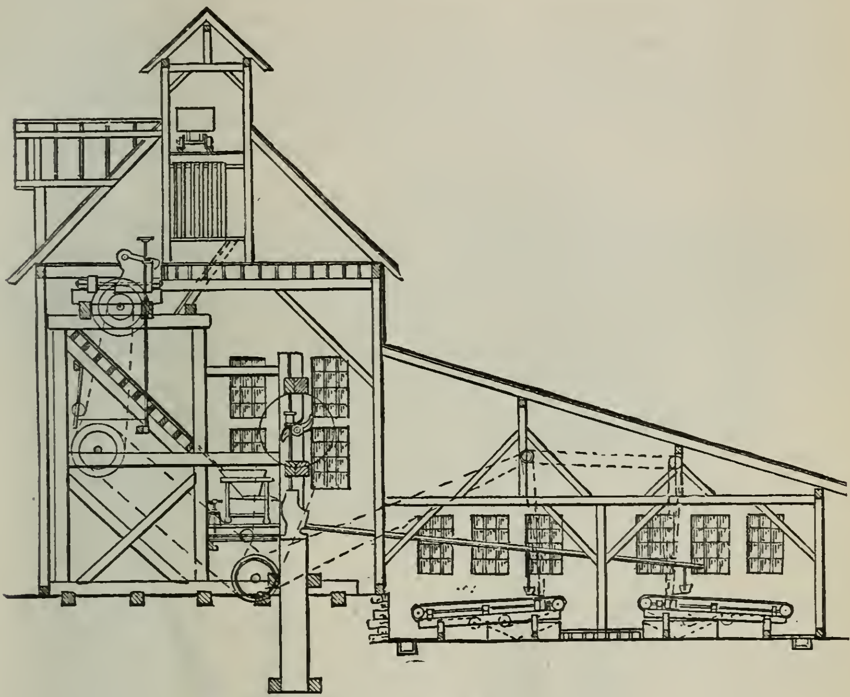
The main body of the belt suffers hardly any wear, as it merely moves its own weight slowly around the freely revolving rollers.

For one machine, ½ inch of water (miner's measure), or 6⅛ gallons a minute, including the water used in crushing, is as large an amount as is ever needed on any material, while on some ores 3 gallons will answer; and by returning the water from the settled tailings ½ gallon will keep up the loss.

The boiler for a 5-stamp mill with 2 concentrators consumes 1 gallon a minute, hence where water is very scarce 2 gallons a minute can supply 5 stamps, 2 Frue vanners, and the boiler.

As regards the capacity of the Frue vanner, about 6 tons per 24 hours passing a 40-mesh screen is as much as it is advisable to treat. If the battery of 5 stamps does its duty, the quantity crushed is largely in excess of 6 tons. For this reason, the best practice is to put 2 Frue vanners to 5

stamps, if the stamps are heavy and the sulphurets high grade and difficult to save; and in such event the pulp is divided, one half passing on each. The machines are generally placed in a double row, on the same level, head to head, as per cut of mill.



Mill Showing Frue Concentrator in Place.

In many cases 3 vanners to 10 stamps will yield entirely satisfactory work, and where the gangue is light, or the stamps not heavy, one vanner treats all the ore crushed with 5 stamps, and does perfect work; *e. g.*, in the Empire mill of 80 stamps, at Plymouth, in Amador County, 16 Frues are concentrating all the ore crushed by the 80 stamps, and the tailings assay merely a trace. No sizing of the ore is needed; the pulp passes directly from the stamps on the copper plates (if used), and thence on the vanners.

In running the machine the point of greatest importance is regularity; regularity in speed; regularity in the delivery of pulp on the belt, and regularity in the supply of clear water. The necessity of this is obvious to any one who thinks of the work to be done by an automatic machine.

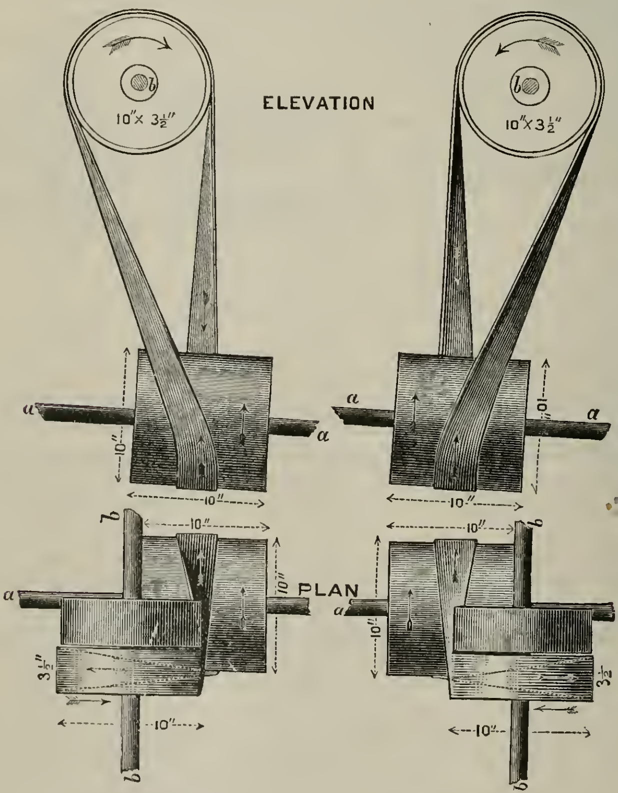
With hand labor the judgment of man regulates the means employed in conformity with varying conditions; but in a machine, the object of which is to supersede hand labor, it becomes obvious that having once adjusted the movements to effect a certain object under certain conditions, the desired result can only be attained by the maintenance of the necessary conditions.

In this concentrator, supposing the inclination of the belt to be fixed for a certain class of material, the regulation of the work to be accomplished is effected by three things, viz.: the speed with which the belt revolves, the

rapidity of the side shake, and the supply of clear water at the head. Having adjusted these three conditions to a given feed delivered on the belt, that feed should remain constant, and the result, both in the richness of mineral collected and in the poverty of the tailings, will be continuously maintained.

The countershaft to drive the Frue concentrators is placed parallel with the cam shaft and main line shaft of the mill, and is, therefore, at right angles to the crank shaft and pulley of the vanner. This necessitates the use of a quarter-twist belt, and the proper placing of this countershaft is very important, for with it properly set, the quarter-twist belt runs as well, as true, and with as little wear as if it were a straight belt; while, if not properly set, it will run off the pulley.

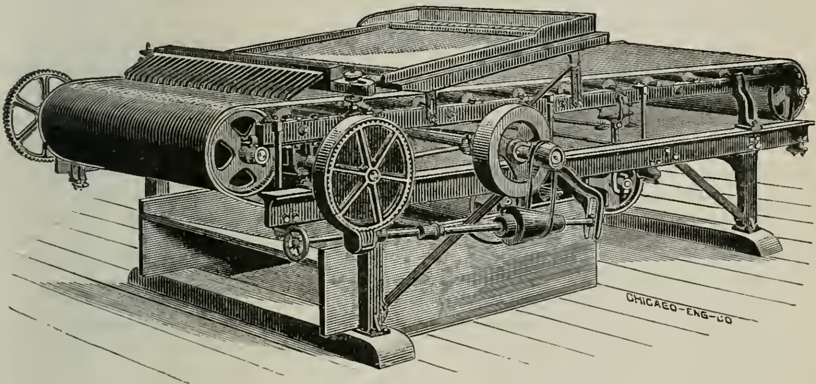
As this is not generally understood, even by good mechanics, the accompanying cut is given to illustrate the placing of this countershaft; *a a* is the crank shaft of the concentration; *b b* is the countershaft; on *b b* are one tight and one loose pulley; the belt is shown on the tight pulley. The crank shaft is not horizontal. The rule is as follows: "In placing the countershaft and its pulley, the pulley should be set so that the side from which the belt leaves it is in line with the square of the crank shaft of the concentrator at that point."



Countershaft for Frue Concentrator.

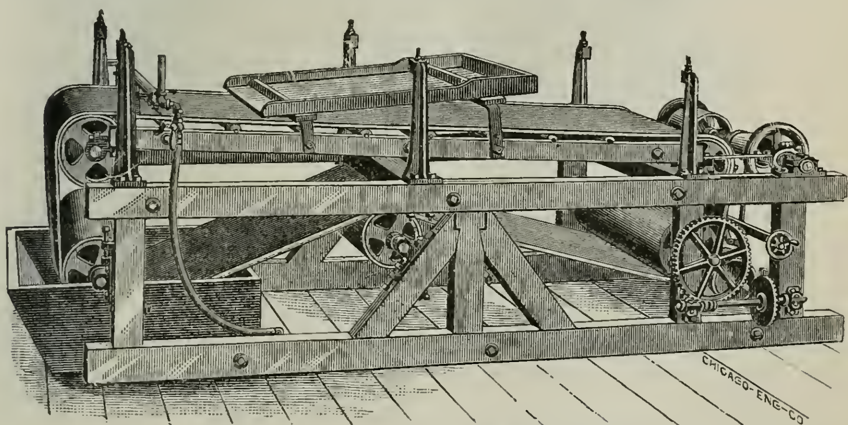
The Embrey concentrator is similar in most respects to the Frue vanner, differing chiefly in the direction of the shake, which is longitudinal. Not many of them have been put in use in California, as the Frue Company owns the Embrey patent, and believing the vanner to be the best machine, they have not pushed the Embrey.

Two forms of the Embrey machine are made, one compact in form, with crank shaft passing under the shaking frame, and supporting, by the latter, the whole weight of the belt and two underhanging rollers. This form is in fact identical with the vanner, except that the crank shaft is placed at right angles to the length of the belt, instead of parallel to same, and it is made with iron or wood frame, as preferred.



Embrey Concentrator, with Iron Frame.

The second form, and the one most desirable for economy in running, is arranged with the driving shaft at the lower end of shafting frame, so that while running all parts can be regulated, and any play taken up, and the shaking frame does not carry the hanging rollers, which are supported by the main frame, and carry about one half of the main belt. The shaking frame and mechanism is thus relieved of the weight of the two lower rollers, and nearly one half of the weight of the heavy belt, an important point, considering the high speed necessary on the end shake machine.



Embrey Concentrator, with Wooden Frame.

The only advantage of the first form over the second is in saving a little floor space for the same length of working belt.

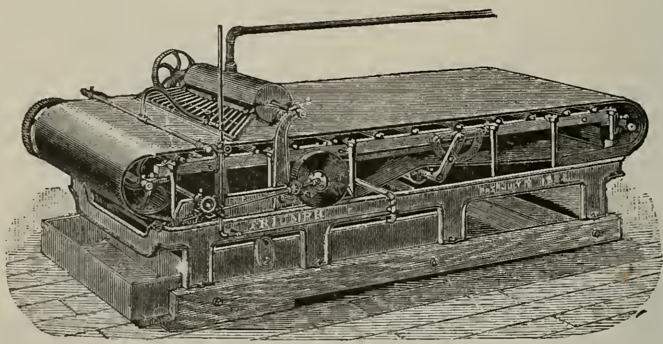
The advantages of the second form are in reduced power required, reduced wear and tear, and greater accessibility of working parts while in motion.

The accompanying cuts show the two forms of the Embrey, as they were made some time ago. Since they were engraved several improvements have been made, but time did not permit later cuts to be made. A few of the improvements consist in mechanism, for regulation of the progressive motion from in front of the machine; and the carrying or shaking frame is now supported from below, in the wooden frame machine, and not from above, as in the cut. Silvered copper plates on the ore distributor are used, when needed, to save amalgam.

If on the same belt both end and side shake mechanism be applied alternately, with the same conditions of feed and speed, it will be found that at a speed of 180 to 200 revolutions per minute, and the ordinary slight inclination of the belt, a perfect separation of clear mineral can be made on most ores with the vanner. If the end shake be substituted now, other conditions being the same, it will be found impossible to keep back the sand from passing over the mineral, even with excessive use of clean water at the head; and a separation can only be accomplished by increasing the speed to 235 or 240 revolutions, and increasing the speed naturally increases the wear and tear very materially.

The Embrey is in use in several mills in Colorado, Montana, the Southern States, etc., and at the Anaconda Copper Mine in Montana, the wooden-frame Embrey is preferred to any other concentrator. One of its patented points is the use of the vibrating water distributor.

The Triumph concentrator (see cut) is very much like the Embrey, which is the earlier machine.



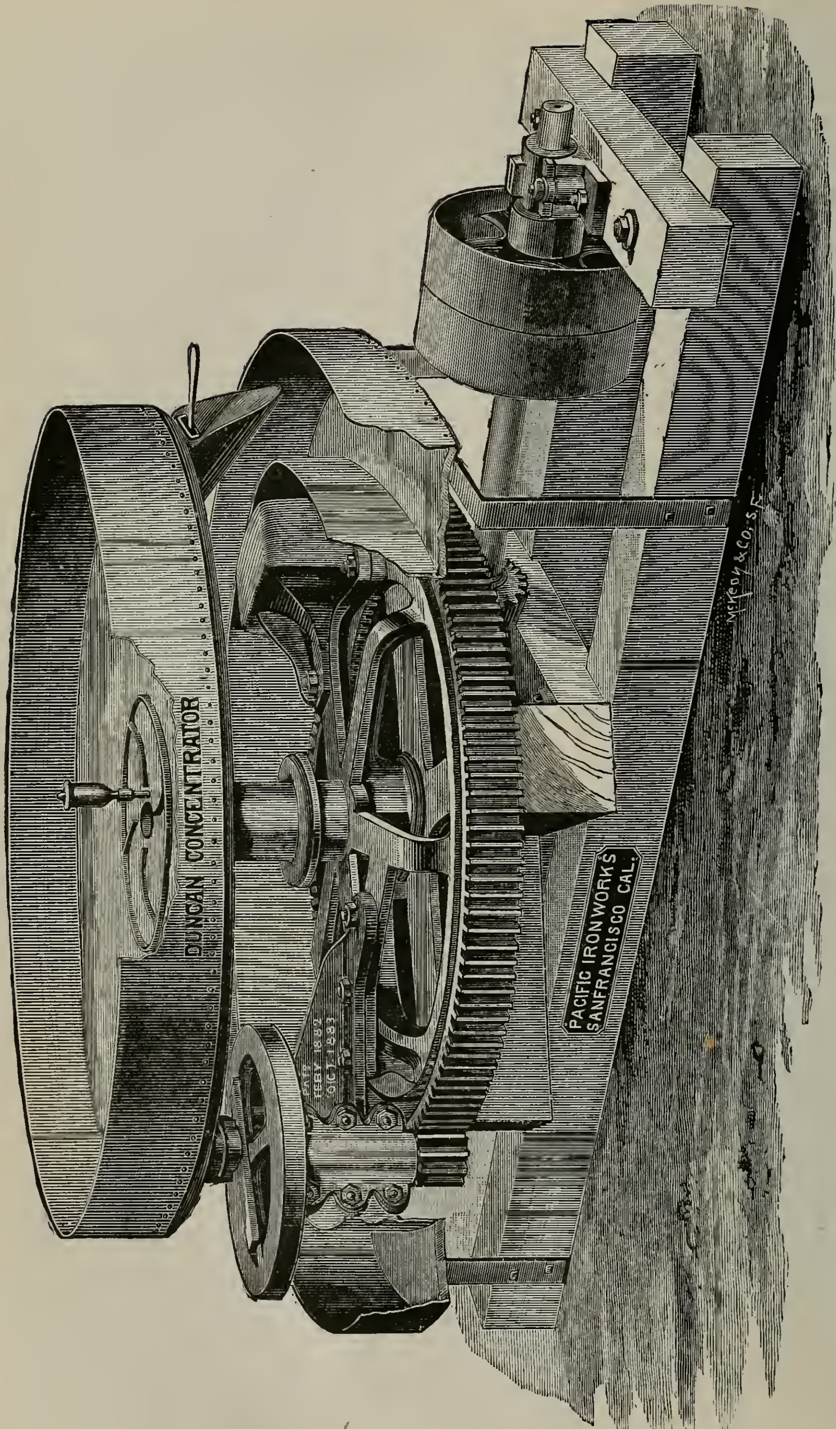
Triumph Concentrator.

It is a rubber belt, inclined, shaking longitudinally, and revolving slowly. Its crank shaft, like the Embrey, revolves from 235 to 240 times a minute, in order to make the separation of the mineral from the sand. Its main novelty is the use of a friction roller to regulate the forward motion of the belt, instead of a cone pulley, which is used in the vanner and Embrey machines. It has also an amalgam saver, consisting of an iron trough in which turns slowly a horizontal shaft, with stirrers. Quicksilver is kept in this trough. The shaking table is supported on upright springs, and the main frame is of cast-iron. It is a neat looking machine,

and can do good work. Many machines have been sold. It is in use at the Empire Mill (Grass Valley), and is liked.

The Duncan ore concentrator, like the Hendy concentrator, is circular in form, and of iron. Its principle is an ingenious combination of movements, imitating the process of panning by hand. "The agitation resulting from this movement causes the mineral to settle to the bottom around the outside of the pan, where it is held by centrifugal force, until discharged through the gates, while the gangue is held in suspension, and gradually carried by the force of the current to the central discharge. The pan, by this centrifugal motion, making, say eight and a half revolutions per minute, causes the pulp to flow around over its surface to the extent of about three revolutions, or equal to a distance of some thirty feet before it is discharged, thereby giving the sulphurets or other mineral time to settle before the gangue passes off.

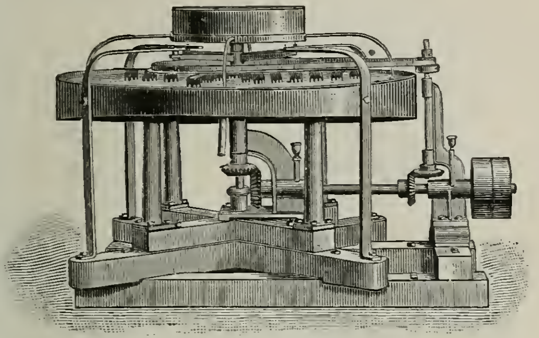
"The wrist-pin, on the balance-wheel, is made adjustable, so that the motion of the pan can be varied to adapt it to the requirements of different classes of ore."



DUNCAN CONCENTRATOR.

The foregoing is the description given by the manufacturers and owners of the Duncan concentrator. It is well made and many have been sold. Its weight is about 1,750 pounds, and it requires to run it about $\frac{1}{2}$-horse power.

Shaw's disk concentrator and amalgamator is of recent introduction, and its merit therefor is not yet settled. It is described as follows by the inventor (please see cut also):



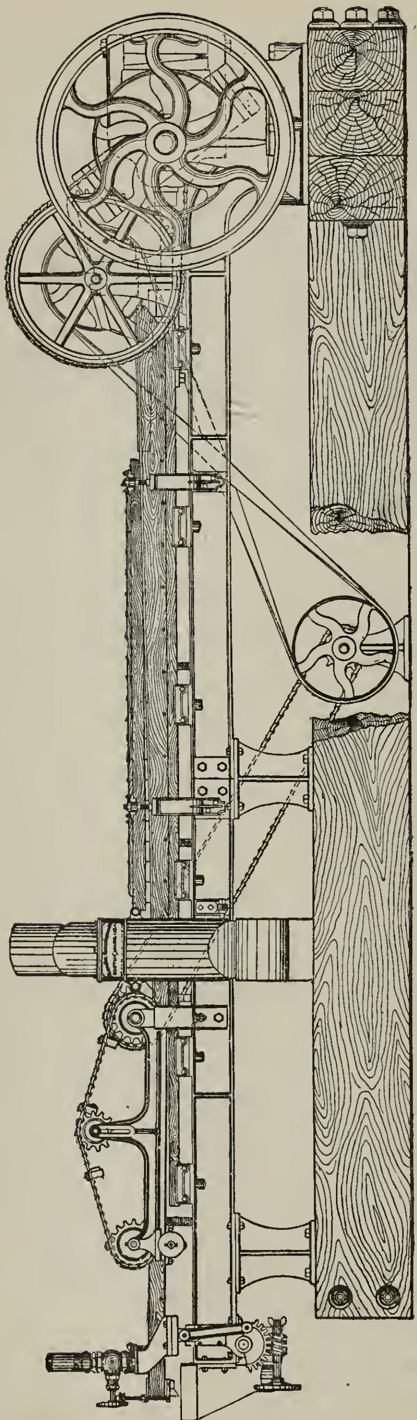
SHAW CONCENTRATOR.

In this machine there is a circular copper disk in the shape of a very shallow cone, with the apex turned downward, to which an eccentric motion of about one half inch throw is communicated by a vertical spindle, which is geared even to a light horizontal shaft, running from 250 to 300 revolutions per minute. The disk does not revolve, being subject only to the eccentric motion, the result being the panning motion, considered so desirable in all concentrating appliances. At work the pulp is received from the mill in the round pan with a perforated bottom supported over the center, passing in the form of rain onto the vibrating disk; the revolving stirrers keep the pulp active, thus allowing the heavier particles contained therein to percolate to the bottom. Coming in contact with the surface of the disk, they move at once towards the center, where a small screen is provided for their egress. The pulp composed of the worthless sands and water pass over the periphery of the disk and are carried off by means of the circular trough provided for that purpose.

In order to assist or retard the motion of the pulp towards the periphery, a number of revolving radial arms are provided, to which are secured at short intervals small notched stirrers of sheet copper, which dip into the pulp to within about a quarter of an inch of the face of the pan or disk. These revolving stirrers regulate the discharge of the pulp; they are set like wings and can be adjusted at different angles so as to throw the pulp out more or less rapidly as desired

It can also be used as an amalgamator by replacing the screen in the center by a close fitting plug and quicksilvering the disk, but it is not intended to be used for its double purpose at the same time.

It is claimed to save the sulphurets clean with little loss, and to have capacity from 5 to 8 tons in 24 hours.



Golden Gate Concentrator.

GOLDEN GATE SULPHURET CONCENTRATOR.

[From a printed description issued by the company.]

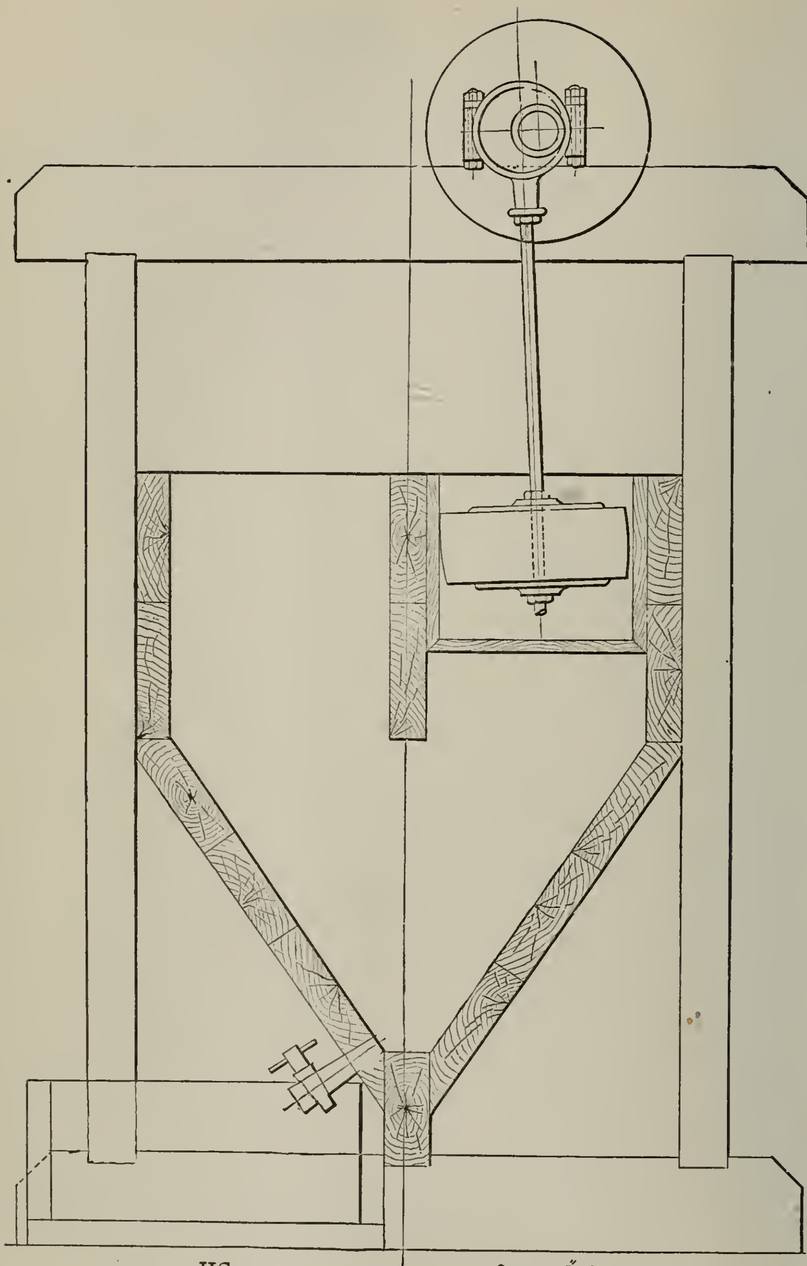
The Golden Gate sulphuret concentrator consists of a tray about eleven feet in length, resting upon a stout iron framework, upon which it has a longitudinally reciprocating movement. This reciprocating movement varies in speed in such manner as to cause the pulp, fed upon the tray at one end, to travel slowly over its surface towards the other end, and the pulp is, by the shaking motion, kept in a loose condition, so that the mineral may settle out of the gangue upon the surface of the tray. The tray proper consists of two distinct parts, forming, however, one continuous surface; one part, being designed for the settling of the mineral, is horizontal, and has hardly any perceptible current of water, thus allowing the fine mineral to settle out of the water and reach the bottom of the tray; the other part has an adjustable inclination upwards from its junction with the horizontal part, and over this part the current of wash water flows, which washes away the gangue from the mineral. At the junction of the horizontal with the inclined part of the tray, and extending across its width, is a "protecting plate," set somewhat above its surface, and parallel thereto. Above the protecting plate is an "exhaust pipe," within which a vacuum, sufficient to sustain a column of four or five inches of water, is constantly maintained by a small exhaust fan. On the lower side of the "exhaust pipe," above the "protecting plate," are openings into which the gangue and water are drawn, by the vacuum maintained, being then discharged over each side of the machine into the waste sluice.

The operation of the sulphuret concentrator is as follows:

The crushed ore, with a suitable amount of water, is fed onto the horizontal part of the tray, through the "distributor" shown at the extreme left of the figure. The peculiar motion communicated to the tray causes the pulp to slowly travel towards the "protecting plate," and at the same time keeps the pulp in a loose condition, allowing the heavier mineral to sink to the bottom, so that, on arriving at the plate, the pulp is separated into distinct layers, with the mineral at the bottom, the heavy gangue above the mineral, and the light gangue and water at the top; the plate having been properly adjusted for the ore, allows all the mineral, with some of the gangue, to pass under it, while the larger part of the gangue, and all the surplus water, pass *above* the plate, and on arriving at the exhaust pipe, are instantaneously drawn off and discharged over the sides of the tray into the waste sluice. That portion of the pulp which has passed under the plate, now consisting largely of mineral, continues on up the inclined part of the tray, where it can be freed from that part of the gangue which is still mixed with it, by a current of water flowing down from the head of the tray, this gangue and wash water being taken away by the exhaust pipe, as before explained.

The machine is very well made and of large capacity. It is in successful operation at the Brunswick Mill, Carson River, Nevada where six of them are handling the product of 56 stamps, crushing 160 tons of ore a day, and is also in use in other places.

There are possible problems in concentration in California requiring coarse crushing; this has already been discussed, and consequently the accompanying cut of one of the most approved styles of jigs should be of interest.



JIG Scale $\frac{3}{8}'' = 1$

Dry concentration is not discussed in this article, because it is little used in California, and in fact is rarely adopted if water can be obtained in sufficient quantity for wet concentration, because the latter gives uniformly better results with less cost, and less wear and tear.

In conclusion, I will state that these notes have been written hurriedly, as but little time was given me in which to prepare them. I have attempted, however, to be fair and just in my statements and criticisms.

CHLORINATION.

(By Wm. Irelan, Jr., State Mineralogist.)

This method of extracting gold from the auriferous sulphurets is recognized in the metallurgical circles of the old world as the Plattner process, and is so called in honor of the inventor. The honor of its introduction and successful adaptation to the working of our sulphuretted residues is due to the well known mining engineer and metallurgist Mr. G. F. Deetken, by whom it was first brought into this country.

Owing to the expense of manipulation, cost of material, and other obstacles, Mr. Deetken had much to contend with, but his well known skill and scientific ability enabled him to reach a successful issue and to become a metallurgical benefactor.

Since the demonstration of its successful workings on our concentrated sulphurets, a general knowledge of the manner of its application has been distributed by means of our scientific and other papers; also, books have been written by two of our well known metallurgists, in which the whole process is explicitly dealt with.

The first of the above mentioned works on the subject was issued by the late G. Kustel, in the year 1868, new edition 1880; and the latest exhaustive description is from the pen of Charles Howard Aaron, in 1881. Both authors were at the time of writing practically engaged in working the sulphurets of the State by this method.

The subject is inexhaustible, and of vital interest to the mining industry of our gold-bearing sections.

This article is not intended to give the detailed manipulations of the process, as the works above cited were written especially as working descriptions, and can be purchased of any of the booksellers.

THE ROAST.

This is the most important of any part of the process, and upon its completeness depends the success of the operation; therefore, too much care cannot be exercised in this branch of the operation.

In roasting, the point to be attained is the complete oxidation of the baser metals whose soluble salts would become precipitants for gold in the leaching vat. If the concentrated sulphurets have become lumpy, it will be necessary to recrush them, that the roast may secure complete oxidation.

It frequently happens that too much material is put into the furnace at one time: Mr. Aaron advises, for the reverbratory, from ten to twelve pounds for every square foot of hearth as the correct charge. The furnace should be fired up several hours before being charged with the dry sulphurets, and the heat should be of a degree just sufficient to ignite the sulphur after the material has been evenly spread over the hearth. Too great a heat will matte the easily fusible sulphides, thereby necessitating a withdrawal of the charge from the furnace and a repulverization. The presence of galena requires a low temperature and continual stirring. Mr. Deetkin discovered that the presence of lime and magnesia, owing to their

affinity for chlorine, were a detriment to the chlorination of the roasted ore, but he overcame this difficulty by an addition of salt to the charge in the furnace toward the completion of the roast. The roasting in all cases should be done at a gentle heat until the sulphur ceases to burn, which point is indicated by the disappearance of the characteristic blue flame, and the absence of scintillation on being raked. The heat is now increased and held at a high temperature until a thorough oxidation of the baser metals takes place. This can be ascertained by agitating, in a glass, a small quantity of the roast with water, allowing to settle, and adding to the clear decantation a few drops of the solution of ferrocyanide of potassium. If a dark blue precipitate is given, sulphate of iron is present; if brownish red, it indicates the presence of the corresponding copper salt; if both copper and iron are present, as soluble salts, the two colors will unite, forming a dirty greenish-blue mass; in either case the oxidation is incomplete, and the roasting must be continued until a further test does not give any of the described reactions.

Many operators continue the roasting to the oxidation of the iron only, but although it takes a longer time and a greater heat, it is advisable to also destroy the copper sulphate, as soluble metallic salts in the leaching vat react upon the iron oxide, which in turn precipitates the gold.

If the concentrated sulphurets contain silver, the Patera and Plattner processes should be combined. The silver is chloridized in the furnace by the addition of salt during the roasting. After the gold is washed from the ore, the silver chloride is leached out by a solution of hyposulphite of soda.

On the completion of the roast, the ore is drawn from the furnace to the cooling hearth, and, after a time, is sprinkled with water until moist enough to adhere when pressed in the hand.

THE LEACHING VAT.

In Europe the leaching is done in earthen or porcelain jars or tubs, wooden vats being condemned on account of their absorbing power. Mr. Deetkin overcame this difficulty by coating the vats on the inside with pitch and tar. The vat is circular, and has a perforated false wooden bottom, which is raised about an inch from the real bottom. This false bottom is covered, first, with a layer of coarse, barren quartz; then a layer of smaller pieces; and, lastly, a covering of clean quartz sand. Sometimes the sand is covered with gunnysacks or perforated boards. The damp roasted pulp is sifted into the vat and spread evenly and loosely until within about three inches of the top. The chlorine gas is now introduced through an opening in the bottom of the tank until it rises to the surface of the ore, which will be known by dense white fumes of chloride of ammonium being given off when a rod or stopper moistened with ammonia is held close to and above the charge. At this point the cover is put in place and carefully luted with some suitable tenacious substance that will not crack in drying. The chlorine is continued until the space above the ore is filled with the dense yellowish-green vapor; then the plug hole in the cover is stopped and the vat and contents are left at rest for from one to two days, at the expiration of which time the gold should be converted into a soluble chloride. Before leaching, the plug in the cover should be removed and the ammonia test applied. If there are no resulting white fumes, the ore must be again subjected to the chlorine, and so continued until the ammonia reaction is given.

The chlorine is generated in a leaden vessel from a mixture of common

salt, peroxide of manganese, sulphuric acid, and water. The reaction chemically given is: $2 (Na\ Cl) + 2 (H_2\ SO_4) + Mn\ O_2 = Na_2\ SO_4 + Mn\ SO_4 + (H_2O)_2 + 2\ Cl$.

Care must be taken in using the chlorine gas that no muriatic acid enters the leaching vat, for, beside attacking the oxides of the metals, should there be an imperfect roast the sulphides would be attacked, eliminating sulphuretted hydrogen gas, which would precipitate the gold from the chloride solution. The chlorine is deprived of the muriatic acid after leaving the generator on its course to the vat by passing the gas through water.

LIXIVIATION AND PRECIPITATION OF THE GOLD.

The ore being thoroughly chlorinated the cover is removed and water run into the vat until it rises above the surface of the mass. After a few minutes, when the water has had sufficient time to permeate all the ore, and still covers the surface, the plug at the bottom of the vat is removed and the liquor conducted to the settling tank into which has been put the precipitant for gold—a solution of sulphate of iron. A continuous flow of water must be admitted into the leaching vat, and at no time during the operation, which lasts several hours, should the water be permitted to fall below the surface of the ore. At intervals a glass full of the liquor, after having left the leaching vat, should be taken and thereto a little of the sulphate of iron solution added; if gold were present a bluish-black precipitate would be given. In the event of any precipitate resulting from the unity of the two solutions the washing is not finished but must be continued until the precipitant added to a freshly taken portion of the liquor does not give any reaction, or at the most only a faint coloration.

After a thorough stirring of the contents in the settling tank, the precipitate is allowed to subside, and a glass full of the clear liquid taken, to which is added a little of the sulphate of iron solution; if a dark coloration is given, more sulphate of iron must be added to the liquor in the tank. Or, if on the addition of a few drops of gold solution to a little of the clear liquid from the tank no reaction is given, it is a confirmation of the former test that there is a deficiency of sulphate of iron.

Should the roasted ore contain chloride of silver, it is leached with a solution of hyposulphite of soda after extraction of the gold by water. The liquor is run into a tank set aside for this especial purpose, in which the silver is thrown down by a solution of calcium sulphide, as sulphide of silver. The outflow of the silver solution should be conducted slowly, by the closing at intervals of the discharge pipe, as the silver salt is not so readily extracted by its solvent as is the gold.

The presence of silver in the hyposulphite is known by the sweet taste of the liquid; but when it can be no longer detected in this wise, a little of the outflow is caught in a glass and a few drops of the calcium sulphide solution added; if a dark precipitate is given, it is reasonable to suppose that the silver has not been entirely extracted, although other metallic salts, giving similar reactions, are also washed out by the same solvent. The only recourse at this point is to apply the confirming tests for such soluble compounds, as it is almost impossible to decide by the coloration which metals may be present. After the silver precipitate in the settling vat has subsided, a little of the calcium sulphide is added to the clear solution, and if a dark coloration is the result, it is evident that more of the precipitant must be added.

After the tests have shown a thorough precipitation of the gold and silver, the tanks are left undisturbed until the suspended precipitates have settled.

SILVER.

The silver precipitate will settle in a few hours, when the clear solution may be drawn off, the silver sulphide collected, conveyed to a filter, washed thoroughly with hot water, pressed, dried, and then roasted in a furnace—first, at a heat just sufficient to drive off the greater part of the sulphur; at this point the temperature should be increased to a dull red, and so continued for several hours, or until the greater part of the silver becomes metallic.

The partly metallized substance is placed with borax and iron scraps in a black lead crucible and fired until thoroughly melted; enough iron should be added that it does not all disappear in the operation. If an iron rod immersed in the molten mass, and allowed to remain a few minutes, shows no signs on removal of having reduced in size—the iron scraps should be removed, the matte and slag skimmed off, and the metal poured.

GOLD.

The contents in this tank should remain at rest for at least forty hours, for under that time a complete precipitation and settling of the gold can not be insured. When the gold has all settled at the bottom of the tank, the clear liquid is drawn off, the gold collected, filtered, washed several times with hot dilute hydrochloric acid, and lastly, with hot water, until all traces of acidity are removed. The gold is now dried, melted in a black lead crucible with borax, skimmed, base metals in a measure removed by the addition of niter, a little at a time, reskimmed, and poured.

The importance of saving sulphurets and working them by this process is shown in the annual statement of the Sierra Buttes Mine. From 1872 to 1885 the sulphurets were collected by the Hendy concentrator, and after exposure to atmospheric oxidation, were worked in the combination Stephenson-Patton pan. In 1885, the company erected chlorination works, at a cost of $5,000, by which they have added a yearly profit of $60,000 to the yield of the mine.

The ore of the Zeile Mine is crushed with special reference to saving the sulphurets; the crushings being sized to pass through a No. 4 slot screen, as finer particles would be more difficult of concentration.

MINERAL PRODUCTS OF THE UNITED STATES, 1885.

The following condensed statement of the mineral production of the United States in the calendar year 1885 is from advance proof sheets of a report shortly to be issued by the United States Geological Survey. This volume will be the third of the series known as "Mineral Resources" reports, prepared by the Division of Mining Statistics and Technology.

Coal.—The total commercial product of coal of all kinds in 1885, exclusive of that consumed at the mines, known as colliery consumption, was 95,834,705 long tons, valued at $152,915,108. Of this 32,265,421 long tons were Pennsylvania anthracite, valued at $72,274,544; while of other coals, including bituminous, brown coal, lignite, and small lots of anthracite produced outside of Pennsylvania, the production was 63,569,284 long tons, valued at $80,640,564 at the points of production. The total production, including colliery consumption, was: Pennsylvania anthracite, 34,228,548 long tons; all other coals, 64,840,668 long tons; making the total absolute production of the coal mines of the United States 99,069,216 long tons, valued as follows: Anthracite, $76,671,948; bituminous, $82,347,648; total, $159,019,596. The total production (including local consumption) of anthracite was 1,052,792 tons in excess of that of 1884, and its value was $10,320,436 greater. The total production of bituminous coal was 8,889,871 tons less than in 1884, but its value was $4,930,582 greater. The total production of coal of all kinds shows a net loss in tonnage of 7,837,079 long tons compared with that of 1884, but a gain in value of $15.251,018, the increase in value being due to an average increase of twenty-five cents per long ton. The total value is about the same as that of 1883.

Coke.—The total production of coke in 1885 was 5,106,696 short tons, valued at the ovens at $7,629,118. Of this Pennsylvania produced 78 per cent, or 3,991,805 tons, valued at $4,981,656. The remainder was produced by fourteen States and Territories. The maximum production of coke in the United States was reached in 1883, when 5,464,721 tons were made. This declined in 1884 to 4,873,805 tons. The production of 1885 shows a gain upon that of 1884, being within 360,000 tons of the make in 1883.

Petroleum.—The total production was 21,842,041 barrels of 42 gallons, of which the Pennsylvania and New York fields produced 20,776,041 barrels. The total value, at an average price of 87½ cents per barrel, was $19,193,694. The production showed a decrease of 2,247,717 barrels and $1,282,600 in value from 1884.

Natural gas.—No record is kept of the yield in cubic feet. The amount of coal displaced by gas in 1885, was 3,161,600 tons, valued at $4,854,200. In 1884 the coal displaced was valued at $1,460,000. The yield has increased tenfold since 1883.

Iron.—The principal statistics for 1885 were: Domestic iron ore consumed, 7,600,000 long tons; value at mine $19,000,000. Imported iron ore consumed, 390,786 long tons; total iron ore conumed, 7,990,786 long tons; pig iron made, 4,044,526 long tons, a decrease of 53,343 tons as compared with 1884; value at furnace $64,712,400, or $9,049,224 less than in 1884. Total spot value of all iron and steel in the first stage of manufacture, excluding all duplications, $93,000,000, a decline of $14,000,000 from 1884.

Gold and silver.—The mint authorities estimate the value of the gold produced in 1885 at $31,801,000, an increase of $1,001,000 over 1884. The production of silver is similarly estimated at $51,600,000, an increase of $2,800,000 over 1884.

Copper.—The production in 1885, including 5,086,841 pounds made from imported pyrites, was 170,962,607 pounds, valued in New York at $18,292,999, at the average price of 10.7 cents per pound. The increase in pounds over 1884 was 25,740,667; in value $503,312.

Lead.—Production, 129,412 short tons. Total value, at an average price of $81 per short ton at the Atlantic coast, $10,469,431, a decline of 10,485 tons and $67,611 in value from the product of 1884. The production of white lead is estimated at 60,000 short tons, worth, at 5¼ cents per pound, $6,300,000.

Zinc.—The production of metallic zinc in 1885 was 40,688 short tons, valued at $3,539,856 at an average value of 4.35 cents per pound, an increase of 2,144 tons and $117,149 in value over 1884. Zinc was also made from the ore directly into zinc white (zinc oxide) to the extent of 15,000 short tons, valued at $1,050,000.

Quicksilver.—Production, 32,073 flasks (of 76½ pounds net), or 160 flasks more than in 1884. Total value, at an average price of $30 53 per flask at San Francisco, $979,189, an increase of $42,861 over 1884. The production of quicksilver vermilion was about 600,000 pounds, the same as in 1884, but the price advanced to 52 cents per pound, making the total value $312,000.

Nickel.—The production of metallic or "grain" nickel was 245,504 pounds, valued at $169,397. In addition, matte and ore containing 32,400 pounds of nickel were exported. Total value of all nickel, $190,000.

Cobalt.—The amount of cobalt oxide was 8,423 pounds, valued at $19,373. The total value of cobalt in ore, matte, and the above oxide was $65,373.

Manganese.—The production of manganese ore was 23,258 long tons, valued at $190,281. Manganiferous iron ore, 3,237 long tons, valued at $17,318. Total value, $207,599.

Chromium.—The production of chrome iron ore was 2,700 long tons, valued at $40,000. The consumption for making potassium and sodium bichromates increased markedly, due to imports of chrome iron ore from Asia Minor.

Tin.—Probably 200 tons of "black tin" ore were made at the concentrating works at the Etta Mine in Dakota. No smelting works have yet been erected.

Platinum.—The amount of crude platinum mined in 1885 was about 250 troy ounces, valued at $187 50 (?). This is exclusive of about 300 ounces of iridosmine, for pointing pens.

Aluminum.—The production of metallic aluminum increased from 1,800 troy ounces in 1884 to 3,400 ounces in 1885, valued at $2,550. Aluminum bronze, containing 10 per cent aluminum, was made to the amount of about 4,500 pounds, valued at $1,800.

Building stone.—Value, $19,000,000; about the same as in 1884.

Brick and tile.—The demand and consequent production increased to an estimated value of $35,000,000 in 1885.

Lime.—With the price constant at 50 cents per barrel at the kilns, the production increased from 37,000,000 barrels in 1884 to 40,000,000 in 1885.

Cement.—The production of cement from natural rock increased to 4,000,000 barrels of 300 pounds each, but was valued at only $3,200,000. Artificial Portland cement amounted to 150,000 barrels of 400 pounds each,

with a total value of $292,500. The total production of cement of all kinds was 4,150,000 barrels, valued at $3,492,500, against $3,720,000 in 1884.

Precious stones.—The value of American precious stones produced in 1885, was $69,900. This includes $42,800 for stones sold as specimens and souvenirs, and $27,100 for stones to be cut into gems. Besides this, gold quartz, with an estimated value of $140,000, was sold for specimens, and for ornaments and jewelry.

Millstones.—The trade in millstones of all kinds has decreased markedly from the introduction of roller mills. The total value of the Esopus millstones in New York, and Cocalico stone in Pennsylvania, did not exceed $100,000 in 1885.

Grindstones.—Estimated value of product for 1885, $500,000.

Phosphates.—With the exception of a local consumption of about 1,000 tons in North Carolina, the total production of phosphate rock came from South Carolina, and amounted to $437,856 long tons of washed rock for the calendar year 1885, valued at $2,846,064, at an average value of $6 50 per ton.

Gypsum.—The estimated production of land plaster in 1885, was 100,600 short tons; of calcined plaster, 72,000 tons; total, 172,800; valued at $959,-600. The above includes 75,100 tons from native stone, the remainder being imported from Nova Scotia.

Salt.—The total production in barrels of 280 pounds, was 7,038,653; exceeding the yield of 1884 by 523,716 barrels. The total value of all salt produced was $4,930,621, an increase of $732,887, which was due partly to the increased value of the Michigan product, and partly to the large increase in the production of western New York.

Bromine.—The production increased slightly, being about 310,000 pounds, against 281,100 in 1884. The total value, at an average of 29 cents per pound, was $89,900, an increase of $22,436 above the previous year.

Borax.—Production, limited to California and Nevada, 8,000,000 pounds; value, at 6 cents per pound for concentrated, $480,000. While the product increased by 1,000,000, the fall in price lowered the total value by $10,000.

Sulphur.—Tho production was only about 700 tons, worth about $18,000.

Pyrites.—About 49,000 long tons were mined, valued at $220,500. In addition 47,500 tons were imported.

Barytes.—The production was about 15,000 tons, valued at $75,000, in the unground condition, as taken from the mines.

Mica.—The production decreased in the West, owing to the inferior value of the sheets obtained. The whole product, excluding waste, was 92,000 pounds, valued at $161,000.

Feldspar.—Production, 13,600 long tons, valued, before grinding, at $68,000.

Asbestus.—The amount mined was about 300 short tons, valued at $9,000.

Asphaltum.—The production remained constant at about 3,000 tons, with a spot value of $10,000.

Mineral Waters.—The sales amounted to $1,312,845, from 9,148,401 gallons; the value is slightly less than in 1884. The great decrease in the number of gallons is due to the exclusion of the water from artesian wells in Madison, Wisconsin, which is used as the regular city supply. A large local consumption is also excluded.

Totals.—The statements made in the last report in regard to the total mineral product require little change for the year 1885. The statistics have been compiled with a view to giving information on those points which are of most interest and utility, and are presented in the form usual in the several branches of trade statistics. Comparing the totals given since 1882, a continuous decrease in value is noted in 1883 and 1884, being marked in the latter year. The year 1885 shows, on the other hand, an increase, due, no doubt, in part to more complete returns and closer estimates, but indicating, nevertheless, a more profitable business year, which would be still more apparent if the last half were compared with the corresponding period in 1884, since in many important branches of trade, prices increased towards the end of the year.

METALLIC PRODUCTS OF THE UNITED STATES IN 1885.

	Quantity.	Value.
Pig iron, spot value—long tons	4,044,525	$64,712,400
Silver, coining value—troy ounces	39,910,279	51,600,000
Gold, coining value—troy ounces	1,538,376	31,801,000
Copper, value at New York City—pounds*	170,962,607	18,292,999
Lead, value at New York City—short tons	129,412	10,469,431
Zinc, value at New York City—short tons	40,688	3,539,856
Quicksilver, value at San Francisco—flasks	32,073	979,189
Nickel, value at Philadelphia—pounds	277,904	191,753
Aluminum, value at Philadelphia—troy ounces	3,400	2,550
Platinum, value, crude, at New York City—troy ounces	250	187
Total		$181,589,365

* Including copper from imported pyrites.

NON-METALLIC MINERAL PRODUCTS OF THE UNITED STATES IN 1885 (SPOT VALUES).

	Quantity.	Value.
Bituminous coal, brown coal, lignite, and anthracite, mined elsewhere than in Pennsylvania—long tons*	64,840,668	$82,347,648
Pennsylvania anthracite—long tons†	34,228,548	76,671,948
Petroleum—barrels	21,842,041	19,193,694
Building stone		19,000,000
Lime—barrels	40,000,000	20,000,000
Salt—barrels	7,038,653	4,825,345
Cement—barrels	4,150,000	3,492,500
South Carolina phosphate rock—long tons	437,856	2,846,064
Limestone for iron flux		1,694,656
Mineral waters—gallons sold	9,148,401	1,312,845
Natural gas		4,854,200
Zinc, white—short tons	15,000	1,050,000
Concentrated borax—pounds	8,000,000	480,000
New Jersey marls—short tons	875,000	437,500
Mica	92,000	161,000
Pyrites	49,000	220,500
Gold quartz souvenirs, jewelry, etc.		140,000
Manganese ore—long tons	23,258	190,281
Crude barytes—long tons	15,000	75,000
Ocher—long tons	3,950	43,575
Precious stones		69,900
Bromine—pounds	310,000	89,900
Feldspar—long tons	13,600	68,000
Chrome iron ore—long tons	2,700	40,000
Asbestus—short tons	300	9,000
Slate ground as a pigment—long tons	1,975	24,687
Sulphur—short tons	715	17,875
Asphaltum—short tons	3,000	10,500
Cobalt oxide—pounds	68,723	65,373
Total		$239,431,991

* The commercial product, that is, the amount marketed, was only 63,569,284 tons, valued at $80,640,564.
† The commercial product, that is, the amount marketed, was only 32,265,421 tons, valued at $72,274,544.

RÉSUMÉ OF THE VALUES OF THE METALLIC AND NON-METALLIC MINERAL SUBSTANCES PRODUCED IN THE UNITED STATES IN 1885.

Metals	$181,589,365
Mineral substances named in the foregoing table	239,431,991
Total	$421,021,356
Estimated value of mineral products unspecified	7,500,000
Grand total	$428,521,356

Summary of the Mineral Products of the United States, Calendar Years 1882, 1883, 1884, and 1885.

Product.	1882.		1883.	
	Quantity.	Value.	Quantity.	Value.
Metallic.				
Pig iron, spot value—long tons	4,623,323	$106,336,429	4,595,510	$91,910,200
Silver, coining value—troy ounces	36,197,695	46,800,000	35,733,622	46,200,000
Gold, coining value—troy ounces	1,572,186	32,500,000	1,451,249	30,000,000
Copper, value at New York City—pounds.	91,646,232	16,038,091	117,151,795	18,064,807
Lead, value at New York City—short tons	132,890	12,624,550	143,957	12,322,719
Zinc, value at New York City—short tons	33,765	3,646,620	36,872	3,311,106
Quicksilver, value at San Francisco—flasks	52,732	1,487,042	46,725	1,253,632
Nickel, value in Philadelphia—pounds	281,616	309,777	58,800	52,920
Antimony, value at San Franccisco—short tons	60	12,000	----------	----------
Platinum, value (crude) at New York City—troy ounces	200	600	200	600
Aluminum, value at Philadelphia—troy ounces	----------	----------	1,000	875
Total value metallic products	----------	$219,755,109	----------	$203,116,859
Non-Metallic (Spot Values).				
Bituminous coal—long tons	60,861,190	$76,076,487	68,531,500	$82,237,800
Pennsylvania anthracite—long tons	31,358,264	70,556,094	34,336,469	77,257,055
Petroleum—barrels	30,053,500	23,704,698	23,400,229	25,740,252
Lime—barrels	31,000,000	21,700,000	32,000,000	19,200,000
Building stone	----------	21,000,000	----------	20,000,000
Salt—barrels	6,412,373	4,340,140	6,192,231	4,211,042
Cement—barrels	3,250,000	3,672,750	4,190,000	4,293,500
Limestone for iron flux—long tons	3,850,000	2,310,000	3,814,273	1,907,136
South Carolina phosphate rock—long tons	332,077	1,992,462	378,380	2,270,280
New Jersey marl—short tons	1,080,000	540,000	972,000	486,000
Borax—pounds	4,236,291	338,903	6,500,000	585,000
Mica—pounds	100,000	250,000	114,000	285,000
Ocher—long tons	7,000	105,000	7,000	84.000
Soapstone—short tons	6,000	90,000	----------	----------
Crude barytes—long tons	20,000	80,000	27,000	108,000
Precious stones	----------	75,000	----------	74,050
Gold-quartz souvenirs, jewelry, etc.	----------	75,000	----------	115,000
Pyrites—long tons	12,000	72,000	25,000	137,500
Manganese ore—long tons	3,500	52,500	8,000	120,000
Chrome iron ore—long tons	2,500	50,000	3,000	60,000
Asbestus—short tons	1,200	36,000	1,000	30,000
Graphite—pounds	425,000	34,000	575,000	46,000
Cobalt oxide—pounds	11,653	32,046	1,096	2,795
Slate ground as pigment—long tons	2,000	24,000	2,000	24,000
Sulphur—short tons	600	21,000	1,000	27,000
Asphaltum—short tons	3,000	10,500	3,000	10,500
Corundum—short tons	500	6,250	----------	----------
Pumice-stone—short tons	70	1,750	----------	----------
Feldspar—long tons	----------	----------	14,100	71,112
Zinc-white—short tons	----------	----------	----------	----------
Bromine—pounds	----------	----------	301,100	72,264
Mineral waters—gallons sold	----------	----------	7,529,423	1,119,603
Natural gas	----------	215,000	----------	475.000
Total value non-metallic mineral products	----------	$227,461,580	----------	$241,049,889
Total value metallic products	----------	219,755,109	----------	203,116,859
Estimated value of mineral products unspecified	----------	8,000,000	----------	8,000,000
Grand total	----------	$455,216,689	----------	$452,166,748

Summary of the Mineral Products of the United States, Etc.—Continued.

Products.	1884.		1885.	
	Quantity.	Value.	Quantity.	Value.
Metallic.				
Pig-iron, spot value—long tons	4,097,868	$73,761,624	4,044,525	$64,712,400
Silver, coining value—troy ounces	37,744,605	48,800,000	39,910,279	51,600,000
Gold, coining value—troy ounces	1,489,949	30,800,000	1,538,376	31,801,000
Copper, value at New York City—pounds	147,805,407	18,106,162	170,962,607	18,292,999
Lead, value at New York City—short tons	139,897	10,537,042	129,412	10,469,431
Zinc, value at New York City—short tons	38,544	3,422,707	40,688	3,539,856
Quicksilver, value at San Francisco—flasks	31,913	936,327	32,073	979,189
Nickel, value at Philadelphia—pounds	64,550	48,412	277,904	191,753
Antimony, value at San Francisco—short tons				
Platinum, value (crude) at New York City—troy ounces	150	450	250	187
Aluminum, value at Philadelphia—troy ounces	1,800	1,350	3,400	2,550
Total value metallic products		$186,414,074		$181,589,365
Non-Metallic (spot values).				
Bituminous coal—long tons	73,730,539	$77,417,066	64,840,668	$82,347,648
Pennsylvania anthracite—long tons	33,175,756	66,351,512	34,228,548	76,671,948
Petroleum—barrels	24,089,758	20,476,294	21,842,041	19,193,694
Lime—barrels	37,000,000	18,500,000	40,000,000	20,000,000
Building stone		19,000,000		19,000,000
Salt—barrels	6,514,937	4,197,734	7,038,653	4,825,345
Cement—barrels	4,000,000	3,720,000	4,150,000	3,492,500
Limestone for iron flux—long tons	3,401,930	1,700,965		1,694,656
South Carolina phosphate rock—long tons	431,779	2,374,784	437,856	2,846,064
New Jersey marls—short tons	875,000	437,500	875,000	437,500
Borax—pounds	7,000,000	490,000	8,000,000	480,000
Mica—pounds	147,410	368,525	92,000	161,000
Ocher—long tons	7,000	84,000	3,950	43,575
Soapstone				
Crude barytes—long tons	25,000	100,000	15,000	75,000
Precious stones		82,975		69,900
Gold quartz souvenirs, jewelry, etc.		140,000		140,000
Pyrites—long tons	35,000	175,000	49,000	220,500
Manganese ore—long tons	10,000	120,000	23,258	190,281
Chrome iron ore—long tons	2,000	35,000	2,700	40,000
Asbestus—short tons	1,000	30,000	300	9,000
Graphite				
Cobalt oxide—pounds	2,000	5,100	68,723	65,373
Slate ground as a pigment—long tons	2,000	20,000	1,975	24,687
Sulphur—short tons	500	12,000	715	17,875
Asphaltum—short tons	3,000	10,500	3,000	10,500
Corundum				
Pumice stone				
Feldspar—long tons	10,900	55,112	13,600	68,000
Zinc-white—short tons	13,000	910,000	15,000	1,050,000
Bromine—pounds	281,100	67,464	310,000	89,900
Mineral waters—gallons sold	10,215,328	1,459,143	9,148,401	1,312,845
Natural gas		1,460,000		4,854,200
Total value non-metallic mineral products		$219,800,674		$239,431,991
Total value metallic products		186,414,074		181,589,365
Estimated value of mineral products unspecified		7,000,000		7,500,000
Grand total		$413,214,748		$428,521,356

MINERAL PRODUCTS OF THE UNITED STATES, CALENDAR YEARS 1882, 1883, 1884, AND 1885.

Products.	1882.		1883.		1884.		1885.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Metallic.								
Pig iron, spot value (*a*)—long tons (*b*)	4,623,323	$106,336,429	4,595,510	$91,910,200	4,097,868	$73,761,624	4,044,525	$64,712,400
Silver, coining value (*c*)—troy ounces	36,197,695	46,800,000	35,733,622	46,200,000	37,744,605	48,800,000	39,910,279	51,600,000
Gold, coining value (*d*)—troy ounces	1,572,186	32,500,000	1,451,249	30,000,000	1,489,949	30,800,000	1,538,376	31,801,000
Copper (*e*) value at N. Y. City—pounds	91,646,232	16,038,091	117,151,795	18,064,807	147,805,407	18,106,162	170,962,607	18,292,999
Lead, value at N. Y. City—short tons	132,890	12,624,550	143,957	12,322,719	139,897	10,537,042	129,412	10,469,431
Zinc, value at N. Y. City—short tons	33,765	3,646,620	36,872	3,311,106	38,544	3,422,707	40,688	3,539,856
Quicksilver, value at San Fran.—flasks (*f*)	52,732	1,487,042	46,725	1,253,632	31,913	936,327	32,073	979,189
Nickel (*g*), value at Philadelphia—lbs.	281,616	309,777	58,800	52,920	64,550	48,412	277,904	191,753
Antimony, value at San Francisco—short tons	60	12,000	(*h*)		(*h*)			
Platinum, value (crude) at New York City—troy ounces	200	600	200	600	150	450	250	187
Aluminum, value at Phila.—troy ounces			1,000	875	1,800	1,350	3,400	2,550
Total value metallic products		$219,755,109		$203,116,859		$186,414,074		$181,589,365
Non-Metallic (spot values).								
Bituminous coal (*i*)—long tons	(*j*) 60,861,190	$76,076,487	(*k*) 68,531,500	$82,237,800	(*l*) 73,730,539	$77,417,066	(*m*) 64,840,668	$82,347,648
Pennsylvania anthracite—long tons	(*n*) 31,358,264	70,556,094	(*o*) 34,336,469	77,257,055	(*p*) 33,175,756	66,351,512	(*q*) 34,228,548	76,671,948
Petroleum—barrels (*r*)	(*s*) 30,053,500	23,704,698	23,400,229	25,740,252	24,089,758	20,476,294	21,842,041	19,193,694
Lime—barrels (*t*)	31,000,000	21,700,000	32,000,000	19,200,000	37,000,000	18,500,000	40,000,000	20,000,000
Building stone		21,000,000		20,000,000		19,000,000		19,000,000
Salt—barrels (*u*)	6,412,373	4,340,140	6,192,231	4,211,042	6,514,937	4,197,734	7,038,653	4,825,345
Cement—barrels (*v*)	3,250,000	3,672,750	4,190,000	4,293,500	4,000,000	3,720,000	4,150,000	3,492,500
Limestone for iron flux—long tons	3,850,000	2,310,000	3,814,273	1,907,136	3,401,930	1,700,965		1,694,656
S. Carolina phosphate rock (*w*)—long tons	332,077	1,992,462	378,380	2,270,280	431,779	2,374,784	(*x*) 437,856	2,846,064
New Jersey marls—short tons	1,080,000	540,000	972,000	486,000	875,000	437,500	875,000	437,500
Borax—pounds	4,236,291	338,903	6,500,000	585,000	7,000,000	490,000	8,000,000	480,000
Mica—pounds	100,000	250,000	114,000	285,000	147,410	368,525	92,000	161,000
Ocher—long tons	7,000	105,000	7,000	84,000	7,000	84,000	3,950	43,575
Soapstone—short tons	6,000	90,000	(*h*)		(*h*)			
Crude barytes—long tons	20,000	80,000	27,000	108,000	25,000	100,000	15,000	75,000
Precious stones		75,000		74,050		82,975		69,900
Gold-quartz souvenirs, jewelry, etc.		75,000		115,000		140,000		140,000

Pyrites—long tons	12,000	72,000	25,000	137,500	35,000	175,000	49,000	220,500
Manganese ore—long tons	3,500	52,500	8,000	120,000	10,000	120,000	23,258	190,281
Chrome iron ore—long tons	2,500	50,000	3,000	60,000	2,000	35,000	2,700	40,000
Asbestus—short tons	1,200	36,000	1,000	30,000	1,000	30,000	300	9,000
Graphite—pounds	425,000	34,000	575,000	46,000				
Cobalt oxide—pounds	11,653	32,046	1,096	2,795	2,000	5,100	(*y*) 68,723	65,373
Slate ground as a pigment—long tons	2,000	24,000	2,000	21,000	2,000	20,000	1,975	24,687
Sulphur—short tons	600	21,000	1,000	27,000	500	12,000	715	17,875
Asphaltum—short tons	3,000	10,500	3,000	10,500	3,000	10,500	3,000	10,500
Corundum—short tons	500	6,250	(*h*)		(*h*)			
Pumice-stone—short tons	70	1,750						
Feldspar—long tons	(*h*)		14,100	71,112	10,900	55,112	13,600	68,000
Zinc-white—short tons	(*h*)		(*h*)		13,000	910,000	15,000	1,050,000
Bromine—pounds	(*h*)		301,100	72,264	281,100	67,464	310,000	89,900
Mineral waters—gallons sold	(*h*)		7,529,423	1,119,603	10,215,328	1,459,143	9,148,401	1,312,845
Natural gas		215,000		475,000		1,460,000		4,851,200
Total value non-metallic mineral products		$227,461,580		$241,019,889		$219,800,674		$239,431,991
Total value metallic products		219,755,109		203,116,859		186,414,074		181,589,365
Estimated value of mineral products unspecified (*z*)		8,000,000		8,000,000		7,000,000		7,500,000
Grand total		$455,216,689		$452,166,748		$413,214,748		$428,521,356

a. By "spot" value is meant value at the point of production.
b. "Long" tons are tons of 2,240 avoirdupois pounds; "short" tons are tons of 2,000 avoirdupois pounds.
c. $1.2929 per troy ounce.
d. $26.6718 per troy ounce.
e. Including copper made from imported pyrites.
f. Of 76½ avoirdupois pounds net.
g. Including nickel in copper-nickel alloy.
h. Not reported.
i. Including brown coal and lignite, and small lots of anthracite mined elsewhere than in Pennsylvania.
j. The commercial product, that is, the amount marketed, was only 57,963,038 tons, worth $72,453,797.
k. The commercial product, that is, the amount marketed, was only 65,030,171 tons, worth $78,036,205.
l. The commercial product, that is, the amount marketed, was only 66,809,356 tons, worth $70,149,824.
m. The commercial product, that is, the amount marketed, was only 63,569,284 tons, valued at $80,640,564.
n. The commercial product, that is, the amount marketed, was only 29,120,096 tons, worth $65,520,216.
o. The commercial product, that is, the amount marketed, was only 31,793,027 tons, worth $71,534,311.
p. The commercial product, that is, the amount marketed, was only 30,718,293 tons, worth $61,436,586.
q. The commercial product, that is, the amount marketed, was only 32,265,421 tons, valued at $72,274,544.
r. Of 42 gallons.
s. From the Pennsylvania and New York fields only; the outside production was very small. For 1883, 1884, and 1885 the figures are complete for the whole United States.
t. Of 200 pounds.
u. Of 280 pounds net.
v. Of 300 pounds for natural cement, and 400 pounds for artificial Portland.
w. Year ending May 31.
x. Calendar year.
y. Including cobalt oxide in ore and matte.
z. Including, where not specified in the table, fire-clay, kaolin, potter's clay, common brick clay, terra cotta, building sand, glass sand, limestone used as flux in lead smelting, limestone in glass making, iron ore used as flux in lead smelting, marls (other than New Jersey), gypsum, tin ore, antimony, iridosmine, mill buhrstone and stone for making grindstones, novaculite, corundum, lithograph stone, talc and soapstone, quartz, feldspar, fluorspar, nitrate of soda, carbonate of soda, sulphate of soda, native alum, ozocerite, mineral soap, strontia, infusorial earth and tripoli, pumice-stone, sienna, umber, zinc-white, bromine, and mineral waters.

U. S. MINING LAWS.

An Act granting the right of way to ditch and canal owners, over the public lands, and for other purposes. (Approved July 26, 1866. U. S. Stats., v. 14, p. 251.)

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That the mineral lands of the public domain, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and occupation by all citizens of the United States, and those who have declared their intention to become citizens, subject to such regulations as may be prescribed by law, and subject also to the local customs or rules of miners in the several mining districts, so far as the same may not be in conflict with the laws of the United States.

Sec. 2. *And be it further enacted*, That whenever any person, or association of persons, claim a vein or lode of quartz, or other rock in place, bearing gold, silver, cinnabar, or copper, having previously occupied or improved the same according to the local customs or rules of miners in the district where the same is situated, and having expended in actual labor and improvements thereon an amount not less than one thousand dollars, and in regard to whose possession there is no controversy or opposing claim, it shall and may be lawful for said claimant, or association of claimants, to file in the local Land Office a diagram of the same, so extended, laterally or otherwise, as to conform to the local laws, customs, and rules of miners, and to enter such tract and receive a patent therefor, granting such mine, together with the right to follow such vein or lode, with its dips, angles, and variations, to any depth, although it may enter the land adjoining, which land adjoining shall be sold subject to this condition.

Sec. 3. *And be it further enacted*, That, upon the filing of the diagram as provided in the second section of this Act, and posting the same in a conspicuous place on the claim, together with a notice of intention to apply for a patent, the Register of the Land Office shall publish a notice of the same in a newspaper published nearest to the location of said claim, and shall also post such notice in his office for the period of ninety days; and after the expiration of said period, if no adverse claim shall have been filed, it shall be the duty of the Surveyor-General, upon application of the party, to survey the premises and make a plat thereof, indorsed with his approval, designating the number and description of the location, the value of the labor and improvements, and the character of the vein exposed; and upon the payment to the proper officer of five dollars per acre, together with the cost of such survey, plat, and notice, and giving satisfactory evidence that said diagram and notice have been posted on the claim during said period of ninety days, the Register of the Land Office shall transmit to the General Land Office said plat, survey, and description, and a patent shall issue for the same thereupon. But said plat, survey, or description shall in no case cover more than one vein or lode, and no patent shall issue for more than one vein or lode, which shall be expressed in the patent issued.

Sec. 4. *And be it further enacted*, That when such location and entry of a mine shall be upon unsurveyed lands, it shall and may be lawful, after the extension thereto of the public surveys, to adjust the surveys to the limits of the premises according to the location and possession and

plat aforesaid; and the Surveyor-General may, in extending the surveys, vary the same from a rectangular form to suit the circumstances of the country and the local rules, laws, and customs of miners; *provided*, that no location hereafter made shall exceed two hundred feet in length along the vein for each locator, with an additional claim for discovery to the discoverer of the lode, with the right to follow such vein to any depth, with all its dips, variations, and angles, together with a reasonable quantity of surface for the convenient working of the same, as fixed by local rules: *and provided further*, that no person may make more than one location on the same lode, and not more than three thousand feet shall be taken in any one claim by any association of persons.

SEC. 5. *And be it further enacted*, That, as a further condition of sale, in the absence of necessary legislation by Congress, the local Legislature of any State or Territory may provide rules for working mines involving easements, drainage, and other necessary means to their complete development: and those conditions shall be fully expressed in the patent.

SEC. 6. *And be it further enacted*, That whenever any adverse claimants to any mine, located and claimed as aforesaid, shall appear before the approval of the survey, as provided in the third section of this Act, all proceedings shall be stayed until final settlement and adjudication, in the Courts of competent jurisdiction, of the rights of possession to such claim, when a patent may issue as in other cases.

SEC. 7. *And be it further enacted*, That the President of the United States be and is hereby authorized to establish additional land districts, and to appoint the necessary officers under existing laws, wherever he may deem the same necessary for the public convenience in executing the provisions of this Act.

SEC. 8. *And be it further enacted*, That the right of way for the construction of highways over public lands, not reserved for public uses, is hereby granted.

SEC. 9. *And be it further enacted*, That whenever, by priority of possession, rights to the use of water for mining, agricultural, manufacturing, or other purposes, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of Courts, the possessors and owners of such vested rights shall be maintained and protected in the same; and the right of way for the construction of ditches and canals for the purposes aforesaid is hereby acknowledged and confirmed: *provided, however*, that whenever, after the passage of this Act, any person or persons shall, in the construction of any ditch or canal, injure or damage the possession of any settler on the public domain, the party committing such injury or damage shall be liable to the party injured for such injury or damage.

SEC. 10. *And be it further enacted*, That wherever, prior to the passage of this Act, upon the lands heretofore designated as mineral lands, which have been excluded from survey and sale, there have been homesteads made by citizens of the United States, or persons who have declared their intention to become citizens, which homesteads have been made, improved, and used for agricultural purposes, and upon which there have been no valuable mines of gold, silver, cinnabar, or copper discovered, and which are properly agricultural lands, the said settlers or owners of such homesteads shall have a right of preëmption thereto, and shall be entitled to purchase the same at the price of one dollar and twenty-five cents per acre, and in quantity not to exceed one hundred and sixty acres; or said parties may avail themselves of the provisions of the Act of Congress, approved May twentieth, eighteen hundred and sixty-two, entitled "An Act

to secure homesteads to actual settlers on the public domain," and Acts amendatory thereof.

SEC. 11. *And be it further enacted*, That, upon the survey of the lands aforesaid, the Secretary of the Interior may designate and set apart such portion of the said lands as are clearly agricultural lands, which lands shall thereafter be subject to preëmption and sale as other public lands of the United States, and subject to all the laws and regulations applicable to the same.

An Act to amend "An Act granting the right of way to ditch and canal owners over the public lands, and for other purposes." (Approved July 9, 1870. U. S. Stats., v. 16, p. 217.)

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That the Act granting the right of way to ditch and canal owners over the public lands, and for other purposes, approved July twenty-sixth, eighteen hundred and sixty-six, be and the same is hereby amended, by adding thereto the following additional sections, numbered twelve, thirteen, fourteen, fifteen, sixteen, and seventeen, respectively, which shall hereafter constitute and form a part of the aforesaid Act:

SEC. 12. *And be it further enacted*, That claims, usually called "placers," including all forms of deposit, excepting veins of quartz, or other rock in place, shall be subject to entry and patent under this Act, under like circumstances and conditions, and upon similar proceedings, as are provided for vein or lode claims; *provided*, that where the lands have been previously surveyed by the United States, the entry in its exterior limits shall conform to the legal subdivisions of the public lands, no further survey or plat in such case being required, and the lands may be paid for at the rate of two dollars and fifty cents per acre; *provided further*, that legal subdivisions of forty acres may be subdivided into ten-acre tracts; and that two or more persons, or association of persons, having contiguous claims of any size, although such claims may be less than ten acres each, may make joint entry thereof; *and provided further*, that no location of a placer claim, hereafter made, shall exceed one hundred and sixty acres for any one person or association of persons, which location shall conform to the United States surveys; and nothing in this section contained shall defeat or impair any bona fide preëmption or homestead claim upon agricultural lands, or authorize the sale of the improvements of any bona fide settler to any purchaser.

SEC. 13. *And be it further enacted*, That where said person or association, they and their grantors, shall have held and worked their said claims for a period equal to the time prescribed by the statute of limitation for mining claims of the State or Territory where the same may be situated, evidence of such possession and working of the claims for such period, shall be sufficient to establish a right to a patent thereto under this Act, in the absence of any adverse claim; *provided, however*, that nothing in this Act shall be deemed to impair any lien which may have attached in any way whatever to any mining claim, or property thereto attached, prior to the issuance of a patent.

SEC. 14. *And be it further enacted*, That all ex parte affidavits required to be made under this Act, or the Act of which it is amendatory, may be verified before any officer authorized to administer oaths within the land district where the claims may be situated.

SEC. 15. *And be it further enacted*, That Registers and Receivers shall

receive the same fees for services under this Act, as are provided by law for like services under other Acts of Congress, and that effect shall be given to the foregoing Act according to such regulations as may be prescribed by the Commissioner of the General Land Office.

SEC. 16. *And be it further enacted*, That so much of the Act of March third, eighteen hundred and fifty-three, entitled "An Act to provide for the survey of the public lands in California, the granting of preëmption rights, and for other purposes," as provides that none other than township lines shall be surveyed where the lands are mineral, is hereby repealed, and the public surveys are hereby extended over all such land; *provided*, that all subdividing of surveyed lands into lots less than one hundred and sixty acres may be done by county and local surveyors at the expense of the claimants; *and provided further*, that nothing herein contained shall require the survey of waste or useless lands.

SEC. 17. *And be it further enacted*, That none of the rights conferred by sections five, eight, and nine of the Act to which this Act is amendatory shall be abrogated by this Act, and the same are hereby extended to all public lands affected by this Act; and all patents granted, or preëmption or homesteads allowed, shall be subject to any vested and accrued water rights, or rights to ditches and reservoirs used in connection with such water rights as may have been acquired under or recognized by the ninth section of the Act of which this Act is amendatory. But nothing in this Act shall be construed to repeal, impair, or in any way affect the provisions of the "Act granting to A. Sutro the right of way and other privileges to aid in the construction of a draining and exploring tunnel to the Comstock lode, in the State of Nevada," approved July twenty-fifth, eighteen hundred and sixty-six.

UNITED STATES MINING LAWS, AND REGULATIONS THEREUNDER.

DEPARTMENT OF THE INTERIOR,
GENERAL LAND OFFICE, October 29, 1881.

GENTLEMEN: Your attention is invited to the Revised Statutes of the United States and the amendments thereto in regard to mining laws and mining resources. Title XXXII, Chapter VI.

SECTION 2318. In all cases lands valuable for minerals shall be reserved from sale, except as otherwise expressly directed by law.

SEC. 2319. All valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and purchase, and the lands in which they are found to occupation and purchase, by citizens of the United States and those who have declared their intention to become such, under regulations prescribed by law, and according to the local customs or rules of miners in the several mining districts, so far as the same are applicable and not inconsistent with the laws of the United States.

SEC. 2320. Mining claims upon veins or lodes of quartz or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits, heretofore located, shall be governed as to length along the vein or lode by the customs, regulations, and laws in force at the date of their location. A mining claim located after the tenth day of May, eighteen hundred and seventy-two, whether located by one or more persons, may

equal, but shall not exceed, one thousand five hundred feet in length along the vein or lode; but no location of a mining claim shall be made until the discovery of the vein or lode within the limits of the claim located. No claim shall extend more than three hundred feet on each side of the middle of the vein at the surface, nor shall any claim be limited by any mining regulation to less than twenty-five feet on each side of the middle of the vein at the surface, except where adverse rights existing on the tenth day of May, eighteen hundred and seventy-two, render such limitation necessary. The end lines of each claim shall be parallel to each other.

Sec. 2321. Proof of citizenship, under this chapter, may consist, in the case of an individual, of his own affidavit thereof; in the case of an association of persons unincorporated, of the affidavit of their authorized agent, made on his own knowledge, or upon information and belief; and in the case of a corporation organized under the laws of the United States, or of any State or Territory thereof, by the filing of a certified copy of their charter or certificate of incorporation.

Sec. 2322. The locators of all mining locations heretofore made or which shall hereafter be made, on any mineral vein, lode, or ledge, situated on the public domain, their heirs and assigns, where no adverse claim exists on the tenth day of May, eighteen hundred and seventy-two, so long as they comply with the laws of the United States, and with the State, Territorial, and local regulations not in conflict with the laws of the United States governing their possessory title, shall have the exclusive right of possession and enjoyment of all the surface included within the lines of their locations, and of all veins, lodes, and ledges throughout their entire depth, the top or apex of which lies inside of such surface lines extended downward vertically, although such veins, lodes, or ledges may so far depart from a perpendicular in their course downward as to extend outside the vertical side-lines of such surface locations. But their right of possession to such outside parts of such veins or ledges shall be confined to such portions thereof as lie between vertical planes drawn downward as above described, through the end-lines of their locations, so continued in their own direction that such planes will intersect such exterior parts of such veins or ledges. And nothing in this section shall authorize the locator or possessor of a vein or lode which extends in its downward course beyond the vertical lines of his claim to enter upon the surface of a claim owned or possessed by another.

Sec. 2323. Where a tunnel is run for the development of a vein or lode, or for the discovery of mines, the owners of such tunnel shall have the right of possession of all veins or lodes within three thousand feet from the face of such tunnel on the line thereof, not previously known to exist, discovered in such tunnel, to the same extent as if discovered from the surface; and locations on the line of such tunnel of veins or lodes not appearing on the surface, made by other parties after the commencement of the tunnel, and while the same is being prosecuted with reasonable diligence, shall be invalid; but failure to prosecute the work on the tunnel for six months shall be considered as an abandonment of the right to all undiscovered veins on the line of such tunnel.

Sec. 2324. The miners of each mining district may make regulations not in conflict with the laws of the United States, or with the laws of the State or Territory in which the district is situated, governing the location, manner of recording, amount of work necessary to hold possession of a mining claim, subject to the following requirements: The location must be distinctly marked on the ground so that its boundaries can be readily traced. All records of mining claims hereafter made shall contain the

name or names of the locators, the date of the location, and such a description of the claim or claims located by reference to some natural object or permanent monument as will identify the claim. On each claim located after the tenth day of May, eighteen hundred and seventy-two, and until a patent has been issued therefor, not less than one hundred dollars' worth of labor shall be performed or improvements made during each year. On all claims located prior to the tenth day of May, eighteen hundred and seventy-two, ten dollars' worth of labor shall be performed or improvements made by the tenth day of June, eighteen hundred and seventy-four, and each year thereafter, for each one hundred feet in length along the vein until a patent has been issued therefor; but where such claims are held in common, such expenditure may be made upon any one claim; and upon a failure to comply with these conditions, the claim or mine upon which such failure occurred shall be open to relocation in the same manner as if no location of the same had ever been made, provided that the original locators, their heirs, assigns, or legal representatives, have not resumed work upon the claim after failure and before such location. Upon the failure of any one of several coöwners to contribute his proportion of the expenditures required hereby, the coöwners who have performed the labor or made the improvements may, at the expiration of the year, give such delinquent coöwner personal notice in writing, or notice by publication in the newspaper published nearest the claim, for at least once a week for ninety days, and if at the expiration of ninety days after such notice in writing or by publication such delinquent should fail or refuse to contribute his proportion of the expenditure required by this section, his interest in the claim shall become the property of his coöwners who have made the required expenditures.

Sec. 2325. A patent for any land claimed and located for valuable deposits may be obtained in the following manner: Any person, association, or corporation authorized to locate a claim under this chapter, having claimed and located a piece of land for such purposes, who has, or have complied with the terms of this chapter, may file in the proper Land Office an application for a patent, under oath, showing such compliance, together with a plat and field-notes of the claim or claims in common, made by or under the direction of the United States Surveyor-General, showing accurately the boundaries of the claim or claims, which shall be distinctly marked by monuments on the ground, and shall post a copy of such plat, together with a notice of such application for a patent, in a conspicuous place on the land embraced in such plat previous to the filing of the application for a patent, and shall file an affidavit of at least two persons that such notice has been duly posted, and shall file a copy of the notice in such Land Office, and shall thereupon be entitled to a patent for the land, in the manner following: The Register of the Land Office, upon the filing of such application, plat, field-notes, notices, and affidavits, shall publish a notice that such application has been made, for the period of sixty days, in a newspaper to be by him designated as published nearest to such claim; and he shall also post such notice in his office for the same period. The claimant at the time of filing this application, or at any time thereafter, within the sixty days of publication, shall file with the Register a certificate of the United States Surveyor-General that five hundred dollars' worth of labor has been expended or improvements made upon the claim by himself or grantors; that the plat is correct, with such further description by such reference to natural objects or permanent monuments as shall identify the claim, and furnish an accurate description, to be incorporated in the patent. At the expiration of the sixty days of publication

the claimant shall file his affidavit, showing that the plat and notice have been posted in a conspicuous place on the claim during such period of publication. If no adverse claim shall have been filed with the Register and the Receiver of the proper Land Office at the expiration of the sixty days of publication, it shall be assumed that the applicant is entitled to a patent, upon the payment to the proper officer of five dollars per acre, and that no adverse claim exists; and thereafter no objection from third parties to the issuance of a patent shall be heard, except it be shown that the applicant has failed to comply with the terms of this chapter.

Sec. 2326. Where an adverse claim is filed during the period of publication, it shall be upon oath of the person or persons making the same, and shall show the nature, boundaries, and extent of such adverse claim, and all proceedings, except the publication of notice and making and filing of the affidavit thereof, shall be stayed until the controversy shall have been settled or decided by a Court of competent jurisdiction, or the adverse claim waived. It shall be the duty of the adverse claimant, within thirty days after filing his claim, to commence proceedings in a Court of competent jurisdiction, to determine the question of the right of possession, and prosecute the same with reasonable diligence to final judgment; and a failure so to do shall be a waiver of his adverse claim. After such judgment shall have been rendered, the party entitled to the possession of the claim, or any portion thereof, may, without giving further notice, file a certified copy of the judgment-roll with the Register of the Land Office, together with the certificate of the Surveyor-General, that the requisite amount of labor has been expended, or improvements made thereon, and the description required in other cases, and shall pay to the Receiver five dollars per acre for his claim, together with the proper fees, whereupon the whole proceedings and the judgment-roll shall be certified by the Register to the Commissioner of the General Land Office, and a patent shall issue thereon for the claim, or such portion thereof as the applicant shall appear, from the decision of the Court, to rightly possess. If it appears from the decision of the Court that several parties are entitled to separate and different portions of the claim, each party may pay for his portion of the claim, with the proper fees, and file the certificate and description by the Surveyor-General, whereupon the Register shall certify the proceedings and judgment-roll to the Commissioner of the General Land Office, as in the preceding case, and patents shall issue to the several parties, according to their respective rights. Nothing herein contained shall be construed to prevent the alienation of a title conveyed by a patent for a mining claim to any person whatever.

Sec. 2327. The description of vein or lode claims, upon surveyed lands, shall designate the location of the claim with reference to the lines of the public surveys, but need not conform therewith; but where a patent shall be issued for claims upon unsurveyed lands, the Surveyor-General, in extending the surveys, shall adjust the same to the boundaries of such patented claim, according to the plat or description thereof, but so as in no case to interfere with or change the location of any such patented claim.

Sec. 2328. Applications for patents for mining claims under former laws now pending may be prosecuted to a final decision in the General Land Office; but in such cases, where adverse rights are not affected thereby, patents may issue in pursuance of the provisions of this chapter; and all patents for mining claims upon veins or lodes heretofore issued shall convey all the rights and privileges conferred by this chapter where

no adverse rights existed on the tenth day of May, eighteen hundred and seventy-two.

Sec. 2329. Claims usually called "placers," including all forms of deposit, excepting veins of quartz or other rock in place, shall be subject to entry and patent, under like circumstances and conditions, and upon similar proceedings, as are provided for vein or lode claims; but where the lands have been previously surveyed by the United States, the entry in its exterior limits shall conform to the legal subdivisions of the public lands.

Sec. 2330. Legal subdivisions of forty acres may be subdivided into ten-acre tracts; and two or more persons, or associations of persons, having contiguous claims of any size, although such claims may be less than ten acres each, may make joint entry thereof; but no location of a placer claim, made after the ninth day of July, eighteen hundred and seventy, shall exceed one hundred and sixty acres for any one person or association of persons, which location shall conform to the United States surveys; and nothing in this section contained shall defeat or impair any bona fide preemption or homestead claim upon agricultural lands, or authorize the sale of the improvements of any bona fide settler to any purchaser.

Sec. 2331. Where placer claims are upon surveyed lands, and conform to legal subdivisions, no further survey or plat shall be required, and all placer mining claims located after the tenth day of May, eighteen hundred and seventy-two, shall conform as near as practicable with the United States system of public land surveys, and the rectangular subdivisions of such surveys, and no such location shall include more than twenty acres for each individual claimant; but where placer claims cannot be conformed to legal subdivisions, survey and plat shall be made as on unsurveyed lands; and where by the segregation of mineral lands in any legal subdivision a quantity of agricultural land less than forty acres remains, such fractional portion of agricultural land may be entered, by any party qualified by law, for homestead or preëmption purposes.

Sec. 2332. Where such person or association, they or their grantors, have held and worked their claims for a period equal to the time prescribed by the statute of limitations for mining claims of the State or Territory where the same may be situated, evidence of such possession and working of the claims for such period shall be sufficient to establish a right to a patent thereto under this chapter, in the absence of any adverse claim; but nothing in this chapter shall be deemed to impair any lien which may have attached in any way whatever to any mining claim or property thereto attached prior to the issuance of a patent.

Sec. 2333. Where the same person, association, or corporation is in possession of a placer claim, and also a vein or lode included within the boundaries thereof, application shall be made for a patent for the placer claim, with the statement that it includes such vein or lode, and in such case a patent shall issue for the placer claim, subject to the provisions of this chapter, including such vein or lode, upon the payment of five dollars per acre for such vein or lode claim, and twenty-five feet of surface on each side thereof. The remainder of the placer claim, or any placer claim not embracing any vein or lode claim, shall be paid for at the rate of two dollars and fifty cents per acre, together with all costs of proceedings; and where a vein or lode, such as is described in section twenty-three hundred and twenty, is known to exist within the boundaries of a placer claim, an application for a patent for such placer claim which does not include an application for the vein or lode claim shall be construed as a conclusive declaration that the claimant of the placer claim has no right of possession

of the vein or lode claim; but where the existence of a vein or lode in a placer claim is not known, a patent for the placer claim shall convey all valuable mineral and other deposits within the boundaries thereof.

Sec. 2334. The Surveyor-General of the United States may appoint in each land district containing mineral lands as many competent surveyors as shall apply for appointment to survey mining claims. The expenses of the survey of vein or lode claims, and the survey and subdivision of placer claims into smaller quantities than one hundred and sixty acres, together with the cost of publication of notices, shall be paid by the applicants, and they shall be at liberty to obtain the same at the most reasonable rates, and they shall also be at liberty to employ any United States Deputy Surveyor to make the survey. The Commissioner of the General Land Office shall also have power to establish the maximum charges for surveys and publication of notices under this chapter; and, in case of excessive charges for publication, he may designate any newspaper published in a land district where mines are situated, for the publication of mining notices in such district, and fix the rates to be charged by such paper; and, to the end that the Commissioner may be fully informed on the subject, each applicant shall file with the Register a sworn statement of all charges and fees paid by such applicant for publication and surveys, together with all fees and money paid the Register and the Receiver of the Land Office, which statement shall be transmitted, with the other papers in the case, to the Commissioner of the General Land Office.

Sec. 2335. All affidavits required to be made under this chapter may be verified before any officer authorized to administer oaths within the land district where the claims may be situated, and all testimony and proofs may be taken before any such officer, and, when duly certified by the officer taking the same, shall have the same force and effect as if taken before the Register and Receiver of the Land Office. In cases of contest as to the mineral or agricultural character of the land, the testimony and proofs may be taken as herein provided, on personal notice of at least ten days to the opposing party; or, if such party cannot be found, then by publication of at least once a week for thirty days, in a newspaper to be designated by the Register of the Land Office, as published nearest to the location of such land; and the Register shall require proof that such notice has been given.

Sec. 2336. Where two or more veins intersect or cross each other, priority of title shall govern; and such prior location shall be entitled to all ore or mineral contained within the space of intersection; but the subsequent location shall have the right of way through the space of intersection, for the purposes of the convenient working of the mine. And where two or more veins unite, the oldest or prior location shall take the vein below the point of union, including all the space of intersection.

Sec. 2337. Where non-mineral land, not contiguous to the vein or lode, is used or occupied by the proprietor of such vein or lode for mining or milling purposes, such non-adjacent surface ground may be embraced and included in an application for a patent for such vein or lode, and the same may be patented therewith, subject to the same preliminary requirements as to survey and notice as are applicable to veins or lodes; but no location hereafter made of such non-adjacent land shall exceed five acres, and payment for the same must be made at the same rate as fixed by this chapter for the superficies of the lode. The owner of a quartz mill or reduction works, not owning a mine in connection therewith, may also receive a patent for his mill site, as provided in this section.

Sec. 2338. As a condition of sale, in the absence of necessary legisla-

tion by Congress, the local Legislature of any State or Territory may provide rules for working mines, involving easements, drainage, and other necessary means to their complete development; and those conditions shall be fully expressed in the patent.

SEC. 2339. Whenever, by priority of possession, rights to the use of water for mining, agricultural, manufacturing, or other purposes, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of Courts, the possessors and owners of such vested rights shall be maintained and protected in the same; and the right of way for the construction of ditches and canals for the purposes herein specified is acknowledged and confirmed; but whenever any person, in the construction of any ditch or canal, injures or damages the possession of any settler on the public domain, the party committing such injury or damage shall be liable to the party injured for such injury or damage.

SEC. 2340. All patents granted, or preëmption or homesteads allowed, shall be subject to any vested and accrued water-rights, or rights to ditches and reservoirs used in connection with such water-rights, as may have been acquired under or recognized by the preceding section.

SEC. 2341. Wherever, upon the lands heretofore designated as mineral lands, which have been excluded from survey and sale, there have been homesteads made by citizens of the United States, or persons who have declared their intention to become citizens, which homesteads have been made, improved, and used for agricultural purposes, and upon which there have been no valuable mines of gold, silver, cinnabar, or copper discovered, and which are properly agricultural lands, the settlers or owners of such homesteads shall have a right of preëmption thereto, and shall be entitled to purchase the same at the price of one dollar and twenty-five cents per acre, and in quantity not to exceed one hundred and sixty acres; or they may avail themselves of the provisions of chapter five of this title, relating to "homesteads."

SEC. 2342. Upon the survey of the lands described in the preceding section, the Secretary of the Interior may designate and set apart such portions of the same as are clearly agricultural lands, which lands shall thereafter be subject to preëmption and sale as other public lands, and be subject to all the laws and regulations applicable to the same.

SEC. 2343. The President is authorized to establish additional land districts, and to appoint the necessary officers under existing laws, wherever he may deem the same necessary for the public convenience in executing the provisions of this chapter.

SEC. 2344. Nothing contained in this chapter shall be construed to impair, in any way, rights or interests in mining property acquired under existing laws; nor to affect the provisions of the Act entitled "an Act granting to A. Sutro the right of way and other privileges to aid in the construction of a draining and exploring tunnel to the Comstock lode, in the State of Nevada," approved July twenty-fifth, eighteen hundred and sixty-six.

SEC. 2345. The provisions of the preceding sections of this chapter shall not apply to the mineral lands situated in the States of Michigan, Wisconsin, and Minnesota, which are declared free and open to exploration and purchase according to legal subdivisions, in like manner as before the tenth day of May, eighteen hundred and seventy-two. And any bona fide entries of such lands within the States named since the tenth of May, eighteen hundred and seventy-two, may be patented without reference to any of the foregoing provisions of this chapter. Such lands shall be

offered for public sale in the same manner, at the same minimum price, and under the same rights of preëmption, as other public lands.

SEC. 2346. No Act passed at the first session of the thirty-eighth Congress, granting lands to States or corporations to aid in the construction of roads, or for other purposes, or to extend the time of grants made prior to the thirtieth day of January, eighteen hundred and sixty-five, shall be so construed as to embrace mineral lands, which in all cases are reserved exclusively to the United States, unless otherwise specially provided in the Act or Acts making the grant.

REPEAL PROVISIONS.

TITLE LXXIV.

SEC. 5595. The foregoing seventy-three titles embrace the statutes of the United States, general and permanent in their nature, in force on the first day of December, one thousand eight hundred and seventy-three, as revised and consolidated by Commissioners appointed under an Act of Congress, and the same shall be designated and cited as the revised statutes of the United States.

SEC. 5596. All Acts of Congress passed prior to said first day of December, one thousand eight hundred and seventy-three, any portion of which is embraced in any section of said revision, are hereby repealed, and the section applicable thereto shall be in force in lieu thereof; all parts of such Acts not contained in such revision, having been repealed or superseded by subsequent Acts, or not being general and permanent in their nature; *provided*, that the incorporation into such revision of any general and permanent provision, taken from an Act making appropriations, or from an Act containing other provisions of a private, local, or temporary character, shall not repeal, or in any way affect any appropriation, or any provision of a private, local, or temporary character, contained in any of said Acts, but the same shall remain in force; and all Acts of Congress passed prior to said last named day, no part of which are embraced in said revision, shall not be affected or changed by its enactments.

SEC. 5597. The repeal of the several Acts embraced in said revision shall not affect any act done, or any right accruing or accrued, or any suit or proceeding had or commenced in any civil cause before the said repeal, but all rights and liabilities under said Acts shall continue, and may be enforced in the same manner, as if said repeal had not been made; nor shall said repeal in any manner affect the right to any office, or change the term or tenure thereof.

SEC. 5598. All offenses committed and all penalties or forfeitures incurred under any statute embraced in said revision prior to said repeal, may be prosecuted and punished in the same manner and with the same effect, as if said repeal had not been made.

SEC. 5599. All acts of limitation, whether applicable to civil causes and proceedings, or to the prosecution of offenses, or for the recovery of penalties or forfeitures, embraced in said revision and covered by said repeal, shall not be affected thereby, but all suits, proceedings, or prosecutions, whether civil or criminal, for causes arising, or acts done or committed prior to said repeal, may be commenced and prosecuted within the same time as if said repeal had not been made.

SEC. 5600. The arrangement and classification of the several sections of the revision have been made for the purpose of a more convenient and

orderly arrangement of the same, and therefore no inference or presumption of a legislative construction is to be drawn by reason of the title under which any particular section is placed.

Sec. 5601. The enactment of the said revision is not to affect or repeal any Act of Congress passed since the first day of December, one thousand eight hundred and seventy-three, and all Acts passed since that date are to have full effect as if passed after the enactment of this revision, and so far as such Acts vary from, or conflict with any provision contained in said revision, they are to have effect as subsequent statutes, and as repealing any portion of the revision inconsistent therewith.

Approved June 22, 1874.

The following is an Act of Congress approved June 6, 1874:

An Act to amend the Act entitled "An Act to promote the development of the mining resources of the United States," passed May tenth, eighteen hundred and seventy-two.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That the provisions of the fifth section of the Act entitled "An Act to promote the development of the mining resources of the United States," passed May tenth, eighteen hundred and seventy-two, which requires expenditures of labor and improvements on claims located prior to the passage of said Act, are hereby so amended that the time for the first annual expenditure on claims located prior to the passage of said Act shall be extended to the first day of January, eighteen hundred and seventy-five.

The following is an Act of Congress approved February 11, 1875:

An Act to amend section two thousand three hundred and twenty-four of the Revised Statutes, relating to the development of the mining resources of the United States.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That section two thousand three hundred and twenty-four of the Revised Statutes be and the same is hereby amended so that where a person or company has or may run a tunnel for the purposes of developing a lode or lodes, owned by said person or company, the money so expended in said tunnel shall be taken and considered as expended on said lode or lodes, whether located prior to or since the passage of said Act, and such person or company shall not be required to perform work on the surface of said lode or lodes in order to hold the same as required by said Act.

The following is an Act of Congress approved May 5, 1876:

An Act to exclude the States of Missouri and Kansas from the provisions of the Act of Congress entitled "An Act to promote the development of the mining resources of the United States," approved May tenth, eighteen hundred and seventy-two.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That within the States of Missouri and Kansas, deposits of coal, iron, lead, or other mineral be and they are hereby excluded from the operation of the Act entitled "An Act to promote the development of the mining resources of the United States," ap-

proved May tenth, eighteen hundred and seventy-two, and all lands in said States shall be subject to disposal as agricultural lands.

The following is an Act of Congress approved June 3, 1878:

An Act authorizing the citizens of Colorado, Nevada, and the Territories to fell and remove timber on the public domain for mining and domestic purposes.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That all citizens of the United States and other persons, bona fide residents of the State of Colorado or Nevada, or either of the Territories of New Mexico, Arizona, Utah, Wyoming, Dakota, Idaho, or Montana, and all other mineral districts of the United States, shall be and are hereby authorized and permitted to fell and remove, for building, agricultural, mining, or other domestic purposes, any timber or other trees growing or being on the public lands, said lands being mineral, and not subject to entry under existing laws of the United States, except for mineral entry, in either of said States, Territories, or districts of which such citizens or persons may be at the time bona fide residents, subject to such rules and regulations as the Secretary of the Interior may prescribe for the protection of the timber and of the undergrowth growing upon such lands, and for other purposes; *provided*, the provisions of this Act shall not extend to railroad corporations.

Sec. 2. That it shall be the duty of the Register and the Receiver of any local Land Office in whose district any mineral land may be situated, to ascertain from time to time whether any timber is being cut or used upon any such lands, except for the purposes authorized by this Act, within their respective land districts; and, if so, they shall immediately notify the Commissioner of the General Land Office of that fact; and all necessary expenses incurred in making such proper examinations shall be paid and allowed such Register and Receiver in making up their next quarterly accounts.

Sec. 3. Any person or persons who shall violate the provisions of this Act, or any rules and regulations in pursuance thereof made by the Secretary of the Interior, shall be deemed guilty of a misdemeanor, and, upon conviction, shall be fined in any sum not exceeding five hundred dollars, and to which may be added imprisonment for any term not exceeding six months.

The following is an Act of Congress approved January 22, 1880:

An Act to amend sections twenty-three hundred and twenty-four and twenty-three hundred and twenty-five of the Revised Statutes of the United States concerning mineral lands.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That section twenty-three hundred and twenty-five of the Revised Statutes of the United States be amended by adding thereto the following words: "*Provided*, that where the claimant for a patent is not a resident of or within the land district wherein the vein, lode, ledge, or deposit sought to be patented is located, the application for patent and the affidavits required to be made in this section by the claimant for such patent may be made by his, her, or its authorized agent, where said agent is conversant with the facts sought to be established by said affidavits; *and provided*, that this section shall apply to all applications now pending for patents to mineral lands."

SEC. 2. That section twenty-three hundred and twenty-four of the Revised Statutes of the United States be amended by adding the following words: "*Provided*, that the period within which the work required to be done annually on all unpatented mineral claims shall commence on the first day of January succeeding the date of location of such claim, and this section shall apply to all claims located since the tenth day of May, Anno Domini eighteen hundred and seventy-two."

The following is an Act of Congress approved March 3, 1881:

An Act to amend section twenty-three hundred and twenty-six of the Revised Statutes of the United States, relating to suits at law affecting the title to mining claims.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That if, in any action brought pursuant to section twenty-three hundred and twenty-six of the Revised Statutes, title to the ground in controversy shall not be established by either party, the jury shall so find, and judgment shall be entered according to the verdict. In such case costs shall not be allowed to either party, and the claimant shall not proceed in the Land Office or be entitled to a patent for the ground in controversy until he shall have perfected his title.

REGULATIONS.

MINERAL LANDS OPEN TO EXPLORATION, OCCUPATION, AND PURCHASE.

1. It will be perceived that by the foregoing provisions of law the mineral lands in the public domain, surveyed or unsurveyed, are open to exploration, occupation, and purchase by all citizens of the United States, and all those who have declared their intentions to become such.

STATUS OF LODE-CLAIMS LOCATED PRIOR TO MAY TENTH, EIGHTEEN HUNDRED AND SEVENTY-TWO.

2. By an examination of the several sections of the Revised Statutes, it will be seen that the *status* of lode-claims located *previous* to the tenth of May, 1872, is not changed with regard to their *extent along the lode or width of surface.*

3. Mining rights acquired under such previous locations are, however, enlarged by said Revised Statutes in the following respect, viz.: The locators of all such previously taken veins or lodes, their heirs and assigns, so long as they comply with the laws of Congress and with State, Territorial, or local regulations not in conflict therewith, governing mining claims, are invested with the exclusive possessory right of all the surface included within the lines of their locations, and of all veins, lodes, or ledges throughout their entire depth, the top or apex of which lies inside of such surface lines extended downward vertically, although such veins, lodes, or ledges may so far depart from a perpendicular in their course downward as to extend outside the vertical side lines of such locations at the surface, it being expressly provided, however, that the right of possession to such outside parts of said veins or ledges shall be confined to such portions thereof as lie between vertical planes drawn downward as aforesaid, through the end lines of their locations so continued in their own direction that

such planes will intersect such exterior parts of such veins, lodes, or ledges; no right being granted, however, to the claimant of such outside portion of a vein or ledge to enter upon the surface location of another claimant.

4. It is to be distinctly understood, however, that the law limits the possessory right to veins, lodes, or ledges, *other* than the one named in the original location, to such as were not *adversely claimed on May 10, 1872*, and that where such other vein or ledge was so adversely claimed at that date, the right of the party so adversely claiming is in no way impaired by the provisions of the Revised Statutes.

5. In order to hold the possessory title to a mining claim located prior to May 10, 1872, and for which a patent has not been issued, the law requires that *ten dollars* shall be expended annually in labor or improvements on each claim of *one hundred feet* on the course of the vein or lode until a patent shall have been issued therefor; but where a number of such claims are held in common upon the same vein or lode, the aggregate expenditure that would be necessary to hold all the claims, at the rate of ten dollars per hundred feet, may be made upon any one claim; a failure to comply with this requirement in any one year subjecting the claim upon which such failure occurred to relocation by other parties, the same as if no previous location thereof had ever been made, unless the claimants under the original location shall have resumed work thereon, after such failure and before such relocation. The first annual expenditure upon claims of this class should have been performed subsequent to May 10, 1872, and prior to January 1, 1875. From and after January 1, 1875, the required amount must be expended *annually* until patent issues. By decision of the honorable Secretary of the Interior, dated March 4, 1879, such annual expenditures are not required subsequent to entry, the date of issuing the patent certificate being the date contemplated by statute.

6. Upon the failure of any one of several coöwners of a vein, lode, or ledge, which has not been entered, to contribute his proportion of the expenditures necessary to hold the claim or claims so held in ownership in common, the coöwners who have performed the labor, or made the improvements, as required by said Revised Statutes, may, at the expiration of the year, give such delinquent coöwner personal notice in writing, or notice by publication in the newspaper published nearest the claim, for at least once a week for ninety days; and, if upon the expiration of ninety days after such notice in writing, or upon the expiration of one hundred and eighty days after the first newspaper publication of notice, the delinquent coöwner shall have failed to contribute his proportion to meet such expenditures or improvements, his interest in the claim by law passes to his coöwners, who have made the expenditures or improvements as aforesaid. Where a claimant alleges ownership of a forfeited interest under the foregoing provision, the sworn statement of the publisher as to the facts of publication, giving dates and a printed copy of the notice published, should be furnished, and the claimant must swear that the delinquent coöwner failed to contribute his proper proportion within the period fixed by the statute.

PATENTS FOR VEINS OR LODES HERETOFORE ISSUED.

7. Rights under patents for veins or lodes heretofore granted under previous legislation of Congress are enlarged by the Revised Statutes so as to invest the patentee, his heirs or assigns, with title to all veins, lodes, or ledges, throughout their entire depth, the top or apex of which lies within the end and side boundary lines of his claim on the surface, as patented, extending downward vertically, although such veins, lodes, or ledges may

so far depart from a perpendicular in their course downward as to extend outside the vertical side lines of the claim at the surface. The right of possession to such outside parts of such veins or ledges to be confined to such portions thereof as lie between vertical planes drawn downward through the end lines of the claims at the surface, so continued in their own direction that such planes will intersect such exterior parts of such veins or ledges, it being expressly provided, however, that all veins, lodes, or ledges, the top or apex of which lies inside such surface locations, *other* than the one named in the patent, which were *adversely claimed on the tenth May, 1872*, are excluded from such conveyance by patent.

8. Applications for patents for mining claims pending at the date of the Act of May 10, 1872, may be prosecuted to final decision in the General Land Office, and where no adverse rights are affected thereby, patents will be issued in pursuance of the provisions of the Revised Statutes.

MANNER OF LOCATING CLAIMS ON VEINS OR LODES AFTER MAY TENTH, EIGHTEEN HUNDRED AND SEVENTY-TWO.

9. From and after the tenth May, 1872, any person who is a citizen of the United States, or who has declared his intention to become a citizen, may locate, record, and hold a mining claim of *fifteen hundred linear feet* along the course of any mineral vein or lode subject to location; or an association of persons, severally qualified as above, may make joint location of such claim of *fifteen hundred feet*, but in no event can a location of a vein or lode made subsequent to May 10, 1872, exceed fifteen hundred feet along the course thereof, whatever may be the number of persons composing the association.

10. With regard to the extent of surface-ground adjoining a vein or lode, and claimed for the convenient working thereof, the Revised Statutes provide that the lateral extent of locations of veins or lodes made after May 10, 1872, shall in no case *exceed three hundred feet on each side of the middle of the vein at the surface*, and that no such surface rights shall be limited by any mining regulations to less than twenty-five feet on each side of the middle of the vein at the surface, except where adverse rights existing on the tenth May, 1872, may render such limitation necessary; the end-lines of such claims to be in all cases parallel to each other. Said lateral measurements cannot extend beyond three hundred feet on *either* side of the middle of the vein at the surface, or such distance as is allowed by local laws. For example: Four hundred feet cannot be taken on one side and two hundred feet on the other. If, however, three hundred feet on each side are allowed, and by reason of prior claims but one hundred feet can be taken on one side, the locator will not be restricted to less than three hundred feet on the other side; and when the locator does not determine by exploration *where* the middle of the vein at the surface is, his discovery shaft must be assumed to mark such point.

11. By the foregoing it will be perceived that no lode-claim located after the tenth May, 1872, can exceed a parallelogram fifteen hundred feet in length by six hundred feet in width, but whether surface-ground of that width can be taken, depends upon the local regulations or State or Territorial laws in force in the several mining districts; and that no such local regulations or State or Territorial laws shall limit a vein or lode claim to less than fifteen hundred feet along the course thereof, whether the location is made by one or more persons, nor can surface rights be limited to less than fifty feet in width, unless adverse claims existing on the tenth day of May, 1872, render such lateral limitation necessary.

12. It is provided by the Revised Statutes that the miners of each district may make rules and regulations not in conflict with the laws of the United States, or of the State or Territory in which such districts are respectively situated, governing the location, manner of recording, and amount of work necessary to hold possession of a claim. They likewise require that the location shall be so distinctively marked on the ground that its boundaries may be readily traced. This is a very important matter, and locators cannot exercise too much care in defining their locations at the outset, inasmuch as the law requires that all records of mining locations made subsequent to May 10, 1872, shall contain the name or names of the locators, the date of the location, and such a *description of the claim or claims* located, by reference to some natural object or permanent monument, as will identify the claim.

13. The statutes provide that no lode-claim shall be recorded until after the discovery of a vein or lode within the limits of the claim located, the object of which provision is evidently to prevent the appropriation of presumed mineral ground for speculative purposes to the exclusion of *bona fide* prospectors, before sufficient work has been done to determine whether a vein or lode really exists.

14. The claimant should, therefore, prior to locating his claim, unless the vein can be traced upon the surface, sink a shaft, or run a tunnel or drift, to a sufficient depth therein to discover and develop a mineral-bearing vein, lode, or crevice; should determine, if possible, the general course of such vein in either direction from the point of discovery, by which direction he will be governed in marking the boundaries of his claim on the surface. His location notice should give the course and distance as nearly as practicable from the discovery-shaft on the claim, to some permanent, well known points or objects, such, for instance, as stone monuments, blazed trees, the confluence of streams, point of intersection of well known gulches, ravines, or roads, prominent buttes, hills, etc., which may be in the immediate vicinity, and which will serve to perpetuate and fix the *locus* of the claim and render it susceptible of identification from the description thereof given in the record of locations in the district, and should be duly recorded.

15. In addition to the foregoing data, the claimant should state the names of adjoining claims, or if none adjoin, the relative positions of the nearest claims; should drive a post or erect a monument of stones at each corner of his surface ground, and at the point of discovery or discovery shaft should fix a post, stake, or board, upon which should be designated the name of the lode, the name or names of the locators, the number of feet claimed, and in which direction from the point of discovery, it being essential that the location notice filed for record, in addition to the foregoing description, should state whether the entire claim of fifteen hundred feet is taken on one side of the point of discovery, or whether it is partly upon one and partly upon the other side thereof, and in the latter case, how many feet are claimed upon each side of such discovery point.

16. Within a reasonable time, say twenty days after the location shall have been marked on the ground, or such time as is allowed by the local laws, notice thereof, accurately describing the claim in manner aforesaid, should be filed for record with the proper Recorder of the district, who will thereupon issue the usual certificate of location.

17. In order to hold the possessory right to a location made since May 10, 1872, not less than one hundred dollars' worth of labor must be performed, or improvements made thereon annually until entry shall have been made. Under the provisions of the Act of Congress approved Jan-

uary 22, 1880, the first annual expenditure becomes due and must be performed during the calendar year succeeding that in which the location was made. Expenditure made or labor performed prior to the first day of January succeeding the date of location will not be considered as a part of, or applied upon the first annual expenditure required by law. Failure to make the expenditure or perform the labor required will subject the claim to relocation by any other party having the necessary qualifications, unless the original locator, his heirs, assigns, or legal representatives have resumed work thereon after such failure and before such relocation.

18. The expenditures required upon mining claims may be made from the surface or in running a tunnel for the development of such claims, the Act of February 11, 1875, providing that where a person or company has, or may, run a tunnel for the purpose of developing a lode or lodes owned by said person or company, the money so expended in said tunnel shall be taken and considered as expended on said lode or lodes, and such person or company shall not be required to perform work on the surface of said lode or lodes in order to hold the same.

19. The importance of attending to these details in the matter of location, labor, and expenditure will be the more readily perceived when it is understood that a failure to give the subject proper attention may invalidate the claim.

TUNNEL RIGHTS.

20. Section 2323 provides that where a tunnel is run for the development of a vein or lode, or for the discovery of mines, the owners of such tunnel shall have the right of possession of all veins or lodes within three thousand feet from the face of such tunnel on the line thereof, not previously known to exist, discovered in such tunnel, to the same extent as if discovered from the surface; and locations on the line of such tunnel of veins or lodes not appearing on the surface, made by other parties after the commencement of the tunnel, and while the same is being prosecuted with reasonable diligence, shall be invalid; but failure to prosecute the work on the tunnel for six months shall be considered as an abandonment of the right to all undiscovered veins or lodes on the line of said tunnel.

21. The effect of this is simply to give the proprietors of a mining tunnel run in good faith the possessory right to fifteen hundred feet of any blind lodes cut, discovered, or intersected by such tunnel, which were not previously known to exist, within three thousand feet from the face or point of commencement of such tunnel, and to prohibit other parties, after the commencement of the tunnel, from prospecting for and making locations of lodes on the *line thereof* and within said distance of three thousand feet, unless such lodes appear upon the surface or were previously known to exist.

22. The term "face," as used in said section, is construed and held to mean the first working-face formed in the tunnel, and to signify the point at which the tunnel actually enters cover; it being from this point that the three thousand feet are to be counted, upon which prospecting is prohibited as aforesaid.

23. To avail themselves of the benefits of this provision of law, the proprietors of a mining tunnel will be required, at the time they enter cover, as aforesaid, to give proper notice of their tunnel location by erecting a substantial post, board, or monument at the face or point of commencement thereof, upon which should be posted a good and sufficient notice, giving the names of the parties or company claiming the tunnel

right; the actual or proposed course or direction of the tunnel; the height and width thereof, and the course and distance from such face or point of commencement to some permanent well known objects in the vicinity by which to fix and determine the *locus* in manner heretofore set forth applicable to locations of veins or lodes, and at the time of posting such notice they shall, in order that miners or prospectors may be enabled to determine whether or not they are within the lines of the tunnel, establish the boundary lines thereof, by stakes or monuments placed along such lines at proper intervals, to the terminus of the three thousand feet from the face or point of commencement of the tunnel, and the lines so marked will define and govern as to the specific boundaries within which prospecting for lodes not previously known to exist is prohibited while work on the tunnel is being prosecuted with reasonable diligence.

24. At the time of posting notice and marking out the lines of the tunnel as aforesaid, a full and correct copy of such notice of location defining the tunnel claim must be filed for record with the mining Recorder of the district, to which notice must be attached the sworn statement or declaration of the owners, claimants, or projectors of such tunnel, setting forth the facts in the case; stating the amount expended by themselves and their predecessors in interest in prosecuting work thereon; the extent of the work performed, and that it is *bona fide* their intention to prosecute work on the tunnel so located and described with reasonable diligence for the development of a vein or lode, or for the discovery of mines, or both, as the case may be. This notice of location must be duly recorded, and, with the said sworn statement attached, kept on the Recorder's files for future reference.

25. By a compliance with the foregoing much needless difficulty will be avoided, and the way for the adjustment of legal rights acquired in virtue of said Section 2323 will be made much more easy and certain.

26. This office will take particular care that no improper advantage is taken of this provision of law by parties making or professing to make tunnel locations, ostensibly for the purposes named in the statute, but really for the purpose of monopolizing the lands lying in front of their tunnels to the detriment of the mining interests and to the exclusion of *bona fide* prospectors or miners, but will hold such tunnel claimants to a strict compliance with the terms of the statutes; and a *reasonable diligence* on their part in prosecuting the work is one of the essential conditions of their implied contract. Negligence or want of due diligence will be construed as working a forfeiture of their right to all undiscovered veins on the line of such tunnel.

MANNER OF PROCEEDING TO OBTAIN GOVERNMENT TITLE TO VEIN OR LODE CLAIMS.

27. By Section 2325 authority is given for granting titles for mines by patent from the Government to any person, association, or corporation having the necessary qualifications as to citizenship and holding the right of possession to a claim in compliance with law.

28. The claimant is required in the first place to have a correct survey of his claim made under authority of the Surveyor-General of the State or Territory in which the claim lies; such survey to show with accuracy the exterior surface boundaries of the claim, which boundaries are required to be distinctly marked by monuments on the ground. Four plats and one copy of the original field notes, in each case, will be prepared by the

Surveyor-General; one plat and the original field notes to be retained in the office of the Surveyor-General, one copy of the plat to be given to the claimant for posting upon the claim, one plat and a copy of the field notes to be given the claimant for filing with the proper Register, to be finally transmitted by that officer, with other papers in the case, to this office, and one plat to be sent by the Surveyor-General to the Register of the proper land district, to be retained on his files for future reference.

29. The claimant is then required to post a copy of the plat of such survey in a conspicuous place upon the claim, together with notice of his intention to apply for a patent therefor, which notice will give the date of posting, the name of the claimant, the name of the claim, mine, or lode; the mining district and county; whether the location is of record, and, if so, where the record may be found; the number of feet claimed along the vein and the presumed direction thereof; the number of feet claimed on the lode in each direction from the point of discovery, or other well defined place on the claim; the name or names of adjoining claimants on the same or other lodes; or, if none adjoin, the names of the nearest claims, etc.

30. After posting the said plat and notice upon the premises, the claimant will file with the proper Register and Receiver a copy of such plat, and the field notes of survey of the claim, accompanied by the affidavit of at least two credible witnesses, that such plat and notice are posted conspicuously upon the claim, giving the date and place of such posting; a copy of *the notice* so posted to be attached to and form a part of said affidavit.

31. Attached to the field notes so filed must be the sworn statement of the claimant that he has the possessory right to the premises therein described, in virtue of a compliance by himself (and by his grantors, if he claims by purchase) with the mining rules, regulations, and customs of the mining district, State, or Territory in which the claim lies, and with the mining laws of Congress; such sworn statement to narrate briefly, but as clearly as possible, the facts constituting such compliance, the origin of his possession, and the basis of his claim to a patent.

32. This affidavit should be supported by appropriate evidence from the mining Recorder's office as to his possessory right, as follows, viz.: Where he claims to be a locator, a full, true, and correct copy of such location should be furnished, as the same appears upon the mining records; such copy to be attested by the seal of the Recorder, or if he has no seal, then he should make oath to the same being correct, as shown by his records; where the applicant claims as a locator in company with others who have since conveyed their interests in the lode to him, a copy of the original record of location should be filed, together with an abstract of title from the proper Recorder, under seal or oath as aforesaid, tracing the co-locator's possessory rights in the claim to such applicant for patent; where the applicant claims only as a purchaser for valuable consideration, a copy of the location record must be filed, under seal or upon oath as aforesaid, with an abstract of title certified as above by the proper Recorder, tracing the right of possession by a continuous chain of conveyances from the original locators to the applicant, also certifying that no conveyances affecting the title to the claim in question appear of record in his office other than those set forth in the accompanying abstract.

33. In the event of the mining records in any case having been destroyed by fire or otherwise lost, affidavit of the fact should be made, and secondary evidence of possessory title will be received, which may consist of the affidavit of the claimant, supported by those of any other parties cognizant of the facts relative to his location, occupancy, possession, improvements, etc.; and in such case of lost records, any deeds, certificates of location or pur-

chase, or other evidence which may be in the claimant's possession, and tend to establish his claim, should be filed.

34. Upon the receipt of these papers the Register will, at the expense of the claimant (who must furnish the agreement of the publisher to hold applicant for patent alone responsible for charges of publication), publish a notice of such application for the period of sixty days, in a newspaper published nearest to the claim; and will post a copy of such notice in his office for the same period. In all cases sixty days must intervene between the first and the last insertion of the notice in such newspaper. When the notice is published in a weekly newspaper, ten consecutive insertions are necessary; when in a daily newspaper, the notice must appear in each issue for the required period.

35. The notices so published and posted must be as full and complete as possible, and embrace all the *data* given in the notice posted upon the claim.

36. Too much care cannot be exercised in the preparation of these notices, inasmuch as upon their accuracy and completeness will depend, in a great measure, the regularity and validity of the whole proceeding.

37. The claimant, either at the time of filing these papers with the Register, or at any time during the sixty days' publication, is required to file a certificate of the Surveyor-General that not less than five hundred dollars' worth of labor has been expended or improvements made upon the claim by the applicant or his grantors; that the plat filed by the claimant is correct; that the field notes of the survey, as filed, furnish such an accurate description of the claim as will, if incorporated into a patent, serve to fully identify the premises, and that such reference is made therein to natural objects or permanent monuments as will perpetuate and fix the *locus* thereof.

38. It will be the more convenient way to have this certificate indorsed by the Surveyor-General, both upon the plat and field notes of survey filed by the claimant as aforesaid.

39. After the sixty days' period of newspaper publication has expired the claimant will file his affidavit, showing that the plat and notice aforesaid remained conspicuously posted upon the claim sought to be patented during said sixty days' publication, giving the dates.

40. Upon the filing of this affidavit the Register will, if no adverse claim was filed in his office during the period of publication, permit the claimant to pay for the land according to the area given in the plat and field notes of survey aforesaid, at the rate of five dollars for each acre, and five dollars for each fractional part of an acre, the Receiver issuing the usual duplicate receipt therefor. The claimant will also make a sworn statement of all charges and fees paid by him for publication and surveys, together with all fees and money paid the Register and Receiver of the Land Office, after which the whole matter will be forwarded to the Commissioner of the General Land Office, and a patent issued thereon, if found regular.

41. In sending up the papers in the case the Register must not omit certifying to the fact that the notice was posted in his office for the full period of sixty days, such certificate to state distinctly when such posting was done, and how long continued.

42. The consecutive series of numbers of mineral entries must be continued, whether the same are of lode or placer claims.

43. The Surveyor-General must continue to designate all surveyed mineral claims as heretofore, by a progressive series of numbers, beginning with lot No. 37 in each township; the claim to be so designated at date

of filing the plat, field notes, etc., in addition to the local designation of the claim, it being required in all cases that the plat and field notes of the survey of a claim must, in addition to the reference to permanent objects in the neighborhood, describe the *locus* of the claim with reference to the lines of public surveys, by a line connecting a corner of the claim with the nearest public corner of the United States surveys, unless such claim be on unsurveyed lands, at a remote distance from such public corner, in which latter case the reference by course and distance to permanent objects in the neighborhood will be a sufficient designation by which to fix the *locus*, until the public surveys shall have been closed upon its boundaries.

ADVERSE CLAIMS.

44. Section 2326 provides for adverse claims, fixes the time within which they shall be filed to have legal effect, and prescribes the manner of their adjustment.

45. Said section requires that the adverse claim shall be filed during the period of publication of notice; that it must be on the oath of the adverse claimant; and that it must show the "*nature*," the "*boundaries*," and the "*extent*" of the adverse claim.

46. In order that this section of law may be properly carried into effect, the following is communicated for the information of all concerned:

47. An adverse mining claim must be filed with the Register of the same Land Office with whom the application for patent was filed, or in his absence, with the Receiver, and within the sixty days' period of newspaper publication of notice.

48. The adverse notice must be duly sworn to by the person or persons making the same, before an officer authorized to administer oaths within the land district, or before the Register or Receiver; it will fully set forth the nature and extent of the interference or conflict; whether the adverse party claims as a purchaser for valuable consideration, or as a locator; if the former, a certified copy of the original location, the original conveyance, a duly certified copy thereof, or an abstract of title from the office of the proper Recorder, should be furnished, or if the transaction was a mere verbal one, he will narrate the circumstances attending the purchase, the date thereof, and the amount paid, which facts should be supported by the affidavit of one or more witnesses, if any were present at the time, and if he claims as a locator, he must file a duly certified copy of the location from the office of the proper Recorder.

49. In order that the "*boundaries*" and "*extent*" of the claim may be shown, it will be incumbent upon the adverse claimant to file a plat, showing his entire claim, its relative situation or position with the one against which he claims, and the extent of the conflict. This plat must be made from an actual survey by a United States Deputy Surveyor, who will officially certify thereon to its correctness; and in addition there must be attached to such plat of survey a certificate or sworn statement by the Surveyor as to the approximate value of the labor performed or improvements made upon the claim by the adverse party or his predecessors in interest, and the plat must indicate the position of any shafts, tunnels, or other improvements, if any such exist, upon the claim of the party opposing the application, and by which party said improvements were made.

50. Upon the foregoing being filed within the sixty days, as aforesaid, the Register, or in his absence the Receiver, will give notice in writing to *both parties* to the contest, that such adverse claim has been filed, informing them that the party who filed the adverse claim will be required within thirty

days from the date of such filing, to commence proceedings in a Court of competent jurisdiction to determine the question of right of possession, and to prosecute the same with reasonable diligence to final judgment, and that should such adverse claimant fail to do so, his adverse claim will be considered waived, and the application for patent be allowed to proceed upon its merits.

51. When an adverse claim is filed as aforesaid, the Register or Receiver will indorse upon the same the precise date of filing, and preserve a record of the date of notifications issued thereon; and thereafter all proceedings on the application for patent will be suspended, with the exception of the completion of the publication, and posting of notices, and plat, and the filing of the necessary proof thereof, until the controversy shall have been adjudicated in Court, or the adverse claim waived or withdrawn.

52. The proceedings after rendition of judgment by the Court in such case are so clearly defined by the act itself as to render it unnecessary to enlarge thereon in this place.

53. The proceedings to obtain patents for claims usually called placers, including all forms of deposit, are similar to the proceedings prescribed for obtaining patents for vein or lode claims; but where said placer claim shall be upon surveyed lands, and conform to legal subdivisions, no further survey or plat will be required, and all placer mining claims located after May 10, 1872, shall conform as nearly as practicable with the United States system of public land surveys and the rectangular subdivisions of such surveys, and no such location shall include more than twenty acres for each individual claimant; but where placer claims cannot be conformed to legal subdivisions, survey and plat shall be made as on unsurveyed lands. But where such claims are located previous to the public surveys, and do not conform to legal subdivisions, survey, plat, and entry thereof may be made according to the boundaries thereof, provided the location is in all respects legal.

54. The proceedings for obtaining patents for veins or lodes having already been fully given, it will not be necessary to repeat them here; it being thought that careful attention thereto by applicants and the local officers will enable them to act understandingly in the matter and make such slight modifications in the notice, or otherwise, as may be necessary in view of the different nature of the two classes of claims, placer claims being fixed, however, at two dollars and fifty cents per acre, or fractional part of an acre.

55. By Section 2330, authority is given for the subdivision of forty-acre legal subdivisions into *ten-acre* lots, which is intended for the greater convenience of miners in segregating their claims both from one another and from intervening agricultural lands.

56. It is held, therefore, that under a proper construction of the law these ten-acre lots in mining districts should be considered and dealt with, to all intents and purposes, as legal subdivisions, and that an applicant having a legal claim which conforms to one or more of these ten-acre lots, either adjoining or cornering, may make entry thereof, after the usual proceedings, without further survey or plat.

57. In cases of this kind, however, the notice given of the application must be very specific and accurate in description, and as the forty-acre tracts may be subdivided into ten-acre lots, either in the form of squares of ten by ten chains, or of parallelograms five by twenty chains, so long as the lines are parallel and at right angles with the lines of the public surveys, it will be necessary that the notice and application state specifi-

cally what ten-acre lots are sought to be patented, in addition to the other *data* required in the notice.

58. Where the ten-acre subdivision is in the form of a square it may be described, for instance, as the "S. E. $\frac{1}{4}$ of the S. W. $\frac{1}{4}$ of N. W. $\frac{1}{4}$," or, if in the form of a parallelogram as aforesaid, it may be described as the "W. $\frac{1}{2}$ of the W. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ (or the N. $\frac{1}{2}$ of the S. $\frac{1}{2}$ of the N. E. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$) of section ——, township ——, range ——," as the case may be; but, in addition to this description of the land, the notice must give all the other *data* that is required in a mineral application, by which parties may be put on inquiry as to the premises sought to be patented. The proof submitted with applications for claims of this kind must show clearly the character and the extent of the improvements upon the premises.

Inasmuch as the Surveyor-General has no duty to perform in connection with the entry of a placer claim of legal subdivisions, the proof of improvements must show their value to be not less than *five hundred dollars* and that they were made by the applicant for patent or his grantors.

59. Applicants for patent to a placer claim, who are also in possession of a known vein or lode included therein, must state in their application that the placer includes such vein or lode. The published and posted notices must also include such statement; and the vein or lode must be surveyed and marked upon the plat; the field notes and plat giving the area of the lode claim or claims and the area of the placer separately. If veins or lodes lying within a placer location are owned by other parties, the fact should be distinctly stated in the application for patent, and in all the notices. It should be remembered that an application which omits to include an application for a known vein or lode therein, must be construed as a conclusive declaration that the applicant has no right of possession to the vein or lode. Where there is no known lode or vein, the fact must appear by the affidavit of claimant and one or more witnesses.

60. When an adverse claim is filed to a placer application, the proceedings are the same as in the case of vein or lode claims, already described.

QUANTITY OF PLACER GROUND SUBJECT TO LOCATION.

61. By Section 2330 it is declared that no location of a placer claim, made after July 9, 1870, shall exceed one hundred and sixty acres for any one person or association of persons, which location shall conform to the United States surveys.

62. Section 2331 provides that all placer mining claims located after May 10, 1872, shall conform as nearly as practicable with the United States system of public surveys and the subdivisions of such surveys, and no such locations shall include more than twenty acres for each individual claimant.

63. The foregoing provisions of law are construed to mean that after the ninth day of July, 1870, no location of a placer claim can be made to exceed one hundred and sixty acres, whatever may be the number of locators associated together, or whatever the local regulations of the district may allow; and that from and after May 10, 1872, no location made by an individual can exceed twenty acres, and no location made by an association of individuals can exceed one hundred and sixty acres; which location of one hundred and sixty acres cannot be made by a less number than eight *bona fide* locators; and no local laws or mining regulations can restrict a placer location to less than twenty acres, although the locator is not compelled to take so much.

64. The regulations hereinbefore given as to the manner of marking loca-

tions on the ground, and placing the same on record, must be observed in the case of placer locations, so far as the same are applicable; the law requiring, however, that where placer claims are upon *surveyed* public lands, the locations must hereafter be made to conform to legal subdivisions thereof as near as practicable.

65. With regard to the proofs necessary to establish the possessory right to a placer claim, Section 2332 provides that "where such person or association, they and their grantors, have held and worked their claims for a period equal to the time prescribed by the statute of limitations for mining claims of the State or Territory where the same may be situated, evidence of such possession and working of the claims for such period shall be sufficient to establish a right to a patent thereto under this chapter, in the absence of any adverse claim."

66. This provision of law will greatly lessen the burden of proof, more especially in the case of old claims located many years since, the records of which, in many cases, have been destroyed by fire, or lost in other ways during the lapse of time, but concerning the possessory right to which all controversy or litigation has long been settled.

67. When an applicant desires to make his proof of possessory right in accordance with this provision of law, you will not require him to produce evidence of location, copies of conveyances, or abstracts of title, as in other cases, but will require him to furnish a duly certified copy of the statute of limitations of mining claims for the State or Territory, together with his sworn statement giving a clear and succinct narration of the facts as to the origin of his title, and likewise as to the continuation of his possession of the mining ground covered by his application; the area thereof, the nature and extent of the mining that has been done thereon; whether there has been any opposition to his possession, or litigation with regard to his claim, and if so, when the same ceased; whether such cessation was caused by compromise or by judicial decree; and any additional facts within the claimant's knowledge having a direct bearing upon his possession and *bona fides* which he may desire to submit in support of his claim.

68. There should likewise be filed a certificate, under seal of the Court having jurisdiction of mining cases within the judicial district embracing the claim, that no suit or action of any character whatever involving the right of possession to any portion of the claim applied for is pending, and that there has been no litigation before said Court affecting the title to said claim, or any part thereof, for a period equal to the time fixed by the statute of limitations for mining claims in the State or Territory as aforesaid, other than that which has been finally decided in favor of the claimant.

69. The claimant should support his narrative of facts relative to his possession, occupancy, and improvements, by corroborative testimony of any disinterested person or persons of credibility who may be cognizant of the facts in the case, and are capable of testifying understandingly in the premises.

70. It will be to the advantage of claimants to make their proofs as full and complete as practicable.

MILL-SITES.

71. Section 2337 provides that "where non-mineral land not contiguous to the vein or lode is used or occupied by the proprietor of such vein or lode for mining or milling purposes, such non-adjacent surface ground may be embraced and included in an application for a patent for such vein or lode, and the same may be patented therewith, subject to the same pre-

liminary requirements as to survey and notice as are applicable to veins or lodes; but no location hereafter made of such non-adjacent land shall exceed five acres, and payment for the same must be made at the same rate as fixed by this chapter for the superficies of the lode. The owner of a quartz mill or reduction works, not owning a mine in connection therewith, may also receive a patent for his mill-site, as provided in this section."

72. To avail themselves of this provision of law, parties holding the possessory right to a vein or lode, and to a piece of non-mineral land not contiguous thereto, for mining or milling purposes, not exceeding the quantity allowed for such purpose by Section 2337, United States Revised Statutes, or prior laws under which the land was appropriated, the proprietors of such vein or lode may file in the proper Land Office their application for a patent, under oath, in manner already set forth herein, which application, together with the plat and field notes, may include, embrace, and describe, in addition to the vein or lode, such non-contiguous mill-site, and after due proceedings as to notice, etc., a patent will be issued conveying the same as one claim.

73. In making the survey in a case of this kind, the lode-claim should be described in the plat and field-notes as "Lot No. 37, A," and the mill-site as "Lot No. 37, B," or whatever may be its appropriate numerical designation; the course and distance from a corner of the mill-site to a corner of the lode-claim to be invariably given in such plat and field notes, and a copy of the plat and notice of application for patent must be conspicuously posted upon the mill-site as well as upon the vein or lode, for the statutory period of sixty days. In making the entry no separate receipt or certificate need be issued for the mill-site, but the whole area of both lode and mill-site will be embraced in one entry, the price being five dollars for each acre and fractional part of an acre embraced by such lode and mill-site claim.

74. In case the owner of a quartz mill or reduction works is not the owner or claimant of a vein or lode, the law permits him to make application therefor in the same manner prescribed herein for mining claims, and after due notice and proceedings, in the absence of a valid adverse filing, to enter and receive a patent for his mill-site at said price per acre.

75. In every case there must be satisfactory proof that the land claimed as a mill-site is not mineral in character, which proof may, where the matter is unquestioned, consist of the sworn statement of the claimant, supported by that of one or more disinterested persons capable from acquaintance with the land to testify understandingly.

76. The law expressly limits mill-site locations made from and after its passage to *five acres.*

77. The Registers and Receivers will preserve an unbroken consecutive series of numbers for all mineral entries.

PROOF OF CITIZENSHIP OF MINING CLAIMANTS.

78. The proof necessary to establish the citizenship of applicants for mining patents must be made in the following manner: In case of an incorporated company, a certified copy of their charter or certificate of incorporation must be filed. In case of an association of persons unincorporated, the affidavit of their duly authorized agent, made upon his own knowledge, or upon information and belief, setting forth the residence of each person forming such association, must be submitted. This affidavit must be accompanied by a power of attorney from the parties forming such associ-

ation, authorizing the person who makes the affidavit of citizenship to act for them in the matter of their application for patent.

79. In case of an individual or an association of individuals who do not appear by their duly authorized agent, you will require the affidavit of each applicant, showing whether he is a native or naturalized citizen, when and where born, and his residence.

80. In case an applicant has declared his intention to become a citizen, or has been naturalized, his affidavit must show the date, place, and the Court before which he declared his intention, or from which his certificate of citizenship issued, and present residence.

81. The affidavit of the claimant as to his citizenship may be taken before the Register or Receiver, or any other officer authorized to administer oaths within the land district. If citizenship is established by the testimony of disinterested persons, such testimony may be taken at any place before any person authorized to administer oaths, and whose official character is duly verified.

APPOINTMENT OF DEPUTY SURVEYORS OF MINING CLAIMS—CHARGES FOR SURVEYS AND PUBLICATIONS—FEES OF REGISTERS AND RECEIVERS, ETC.

82. Section 2334 provides for the appointment of surveyors of mineral claims, authorizes the Commissioner of the General Land Office to establish the rates to be charged for surveys and for newspaper publications, prescribes the fees allowed to the local officers for receiving and acting upon applications for mining patents and for adverse claims thereto, etc.

Under this authority of law the following rates have been established as the maximum charges for newspaper publications in mining cases:

a. Where a daily newspaper is designated the charge shall not exceed seven dollars for each ten lines of space occupied, and where a weekly newspaper is designated as the medium of publication, five dollars for the same space will be allowed. Such charge shall be accepted as full payment for publication in each issue of the newspaper for the entire period required by law.

It is expected that these notices shall not be so abbreviated as to curtail the description essential to a perfect notice, and the said rates established upon the understanding that they are to be in the usual body-type used for advertisements.

b. For the publication of citations in contests or hearings involving the character of lands, the charges shall not exceed eight dollars for five publications in weekly newspapers, or ten dollars for publications in daily newspapers for thirty days.

83. The Surveyors-General of the several districts will, in pursuance of said law, appoint in each land district as many *competent* deputies for the survey of mining claims as may seek such appointment; it being distinctly understood that all expenses of these notices and surveys are to be borne by the mining claimants and not by the United States; the system of making *deposits* for mineral surveys, as required by previous instructions, being hereby revoked as regards *field work;* the claimant having the option of employing *any* deputy surveyor within such district to do his work in the field.

84. With regard to the *platting* of the claim and other *office work* in the Surveyor-General's Office, that officer will make an estimate of the cost thereof, which amount the claimant will deposit with any Assistant United States Treasurer, or designated depository, in favor of the United States Treasurer, to be passed to the credit of the fund created by "individual

depositors for surveys of the public lands," and file with the Surveyor-General duplicate certificate of such deposit in the usual manner.

85. The Surveyors-General will endeavor to appoint mineral deputy surveyors, so that one or more may be located in each mining district for the greater convenience of miners.

86. The usual oaths will be required of these deputies and their assistants as to the correctness of each survey executed by them.

The duty of the deputy mineral surveyor ceases when he has executed the survey and returned the field notes and preliminary plat thereof with his report to the Surveyors-General. He will not be allowed to prepare for the mining claimant the papers in support of an application for patent, or otherwise perform the duties of an attorney before the Land Office in connection with a mining claim.

The Surveyor-General and local land officers are expected to report any infringement of this regulation to this office.

87. The law requires that each applicant shall file with the Register and Receiver a sworn statement of all charges and fees paid by him for publication of notice and for survey; together with all fees and money paid the Register and Receiver, which sworn statement is required to be transmitted to this office, for the information of the Commissioner.

88. Should it appear that excessive or exorbitant charges have been made by any surveyor, or any publisher, prompt action will be taken with the view of correcting the abuse.

89. The fees payable to the Register and Receiver for filing and acting upon applications for mineral land patents are five dollars to each officer, to be paid by the applicant for patent at the time of filing, and the like sum of five dollars is payable to each officer by an adverse claimant at the time of filing his adverse claim.

90. All fees or charges under this law may be paid in United States currency.

91. The Register and Receiver will, at the close of each month, forward to this office an abstract of mining applications filed, and a register of receipts, accompanied with an abstract of mineral lands sold, and an abstract of adverse claims filed.

92. The fees and purchase money received by Registers and Receivers must be placed to the credit of the United States in the Receiver's monthly and quarterly account, charging up in the disbursing account the sums to which the Register and Receiver may be, respectively, entitled as fees and commissions, with limitations in regard to the legal maximum.

HEARINGS TO ESTABLISH THE CHARACTER OF LANDS.

93. In every case where it becomes necessary, under the law and existing instructions of this office, that a hearing be held and testimony taken for the purpose of ascertaining the mineral or agricultural character of land, the local officers are directed to cause the evidence to be taken before a duly qualified officer, whose office is located nearest the land in dispute, the distance to be computed by ordinary routes of travel.

Whenever the local office comes within this rule, the hearing will be held before the Register and Receiver.

It is intended to cause these hearings to be held, as far as practicable, in such manner as to afford the least inconvenience to persons interested. Should it appear, therefore, by written stipulation of all the parties, that this purpose will best be subserved by the designation of any particular officer authorized to administer oaths within the land district in which the

land in controversy is situated, the instructions herein may be departed from in accordance with such stipulation. Such deviation may also be allowed where the officer who would, otherwise, be designated is an interested party, or where, for other good reasons, his selection would be improper.

When the evidence is taken before an officer other than the Register and Receiver, the record should be sealed up, the title of the case indorsed on the envelope, and the whole returned by mail or express to the Register and Receiver.

On the twenty-seventh April, 1880, in accordance with the directions of the Secretary of the Interior, this office revoked the withdrawals theretofore made, upon general information, that vast tracts of public land were mineral in character, and instructed the local officers, in the absence of a specific allegation of the mineral character of land, to allow applications for agricultural entry thereof, upon due proof.

Hereafter the only tracts of public lands that will be withheld from entry as agricultural land on account of its mineral character, will be such as are returned by the Surveyor-General as mineral; and even the presumption which is supported by such return may be overcome by testimony taken at a regular hearing.

94. Hearings to determine the character of land, as practically distinguished, are of two kinds:

First—Where lands which are sought to be entered and patented as agricultural are alleged by affidavit to be mineral, or when sought as mineral their non-mineral character is alleged.

The proceedings relative to this class are in the nature of a contest between two or more known parties, and the testimony may be taken on personal notice of at least ten days, duly served on all parties, or, if they cannot be found, then by publication for thirty days in a newspaper of general circulation, to be designated by the Register of the Land Office as published nearest to the land in controversy. If publication is made in a weekly newspaper, the notice must be inserted in five consecutive weekly issues thereof.

Second—When lands are returned as mineral by the Surveyor-General.

When such lands are sought to be entered as agricultural, notice must be given by publication for thirty days, as aforesaid.

95. All notices must describe the land, give the name and address of the claimant, the character of his claim, and the time, place, and purpose of the hearing.

Proof of service of notice, when personal, must consist of either acknowledgment of service indorsed on the citation (which is always desirable), or the affidavit of the party serving the same, giving date, place, and manner of service, indorsed as aforesaid.

Proof of publication must be the affidavit of the publisher of the newspaper, stating the period of publication, giving dates, stating whether in a daily or weekly issue, and a copy of the notice so published must be attached to and form a part of the affidavit.

Proof of posting on the claim must be made by the affidavits of two or more persons who state when and where the notice was posted; that it remained so posted during the prescribed period, giving dates, and a copy of the notice so posted must be attached to and made a part of the affidavits.

Proof of notice is indispensable to the regularity of proceedings and must accompany the record in every case.

The expense of notice must in every case be paid by the parties thereto.

96. At the hearing there must be filed the affidavit of the publisher of

the paper that said notice was published for the required time, stating when and for how long such publication was made, a printed copy thereof to be attached and made a part of the affidavit.

97. At the hearing the claimants and witnesses will be thoroughly examined with regard to the character of the land; whether the same has been thoroughly prospected; whether or not there exists within the tract or tracts claimed any lode or vein of quartz or other rock in place, bearing gold, silver, cinnabar, lead, tin, or copper, or other valuable deposit which has ever been claimed, located, recorded, or worked; whether such work is entirely abandoned, or whether occasionally resumed; if such lode does exist, by whom claimed, under what designation, and in which subdivision of the land it lies; whether any placer mine or mines exist upon the land; if so, what is the character thereof—whether of the shallow surface description, or of the deep cement, blue lead, or gravel deposits; to what extent mining is carried on when water can be obtained, and what the facilities are for obtaining water for mining purposes; upon what particular ten-acre subdivisions mining has been done, and at what time the land was abandoned for mining purposes, if abandoned at all.

98. The testimony should also show the agricultural capacities of the land, what kind of crops are raised thereon, and the value thereof; the number of acres actually cultivated for crops of cereals or vegetables, and within which particular ten-acre subdivision such crops are raised; also which of these subdivisions embrace his improvements, giving in detail the extent and value of his improvements, such as house, barn, vineyard, orchard, fencing, etc.

99. It is thought that bona fide settlers upon lands really agricultural will be able to show, by a clear, logical, and succinct chain of evidence, that their claims are founded upon law and justice; while parties who have made little or no permanent agricultural improvements, and who only seek title for speculative purposes, on account of the mineral deposits known to themselves to be contained in the land, will be defeated in their intentions.

100. The testimony should be as full and complete as possible; and, in addition to the leading points indicated above, everything of importance bearing upon the question of the character of the land should be elicited at the hearing.

101. Where the testimony is taken before an officer who does not use a seal, other than the Register and Receiver, the official character of such officer must be attested by a clerk of a Court of record, and the testimony transmitted to the Register and Receiver, who will thereupon examine and forward the same to this office, with their joint opinion as to the character of the land as shown by the testimony.

102. When the case comes before this office, such an award of the land will be made as the law and the facts may justify; and in cases where a survey is necessary to set apart the mineral from the agricultural land in any forty-acre tract, the necessary instructions will be issued to enable the agricultural claimant, *at his own expense*, to have the work done, at his option, either by United States deputy, county, or other local surveyor; the survey in such case may be executed in such manner as will segregate the portion of land actually containing the mine, and used as surface-ground for the convenient working thereof, from the remainder of the tract, which remainder will be patented to the agriculturist to whom the same may have been awarded, subject, however, to the condition that the land may be entered upon by the proprietor of any vein or lode for which a

patent has been issued by the United States for the purpose of extracting and removing the ore from the same, where found to penetrate or intersect the land so patented as agricultural, as stipulated by the mining Act.

103. Such survey when executed must be properly sworn to by the Surveyor, either before a Notary Public, officer of a Court of record, or before the Register or Receiver, the deponent's character and credibility to be properly certified to by the officer administering the oath.

104. Upon the filing of the plat and field notes of such survey, duly sworn to as aforesaid, you will transmit the same to the Surveyor-General for his verification and approval; who, if he finds the work correctly performed, will properly mark out the same upon the original township plat in his office, and furnish authenticated copies of such plat and description both to the proper local Land Office and to this office, to be affixed to the duplicate and triplicate township plats respectively.

105. In cases where a portion of a forty-acre tract is awarded to an agricultural claimant, and he causes the segregation thereof from the mineral portion, as aforesaid, such agricultural portion will not be given a numerical designation, as in the case of surveyed mineral claims, but will simply be described as the "Fractional —— quarter of the —— quarter of section ——, in township ——, of range ——, —— meridian, containing —— acres, the same being exclusive of the land adjudged to be mineral in said forty-acre tract."

106. The Surveyor must correctly compute the area of such agricultural portion, which computation will be verified by the Surveyor-General.

107. After the authenticated plat and field notes of the survey have been received from the Surveyor-General, this office will issue the necessary order for the entry of the land, and in issuing the Receiver's receipt and Register's patent certificate you will invariably be governed by the description of the land given in the order from this office.

108. The fees for taking testimony and reducing the same to writing in these cases will have to be defrayed by the parties in interest. Where such testimony is taken before any other officer than the Register and Receiver, the Register and Receiver will be entitled to no fees.

109. If, upon a review of the testimony at this office, a ten-acre tract should be found to be properly mineral in character, that fact will be no bar to the execution of the settler's legal right to the remaining *non-mineral* portion of his claim, if contiguous.

110. No fear need be entertained that miners will be permitted to make entries of tracts ostensibly as mining claims, which are not mineral, simply for the purpose of obtaining possession and defrauding settlers out of their valuable agricultural improvements, it being almost an impossibility for such a fraud to be consummated under the laws and regulations applicable to obtaining patents for mining claims.

111. The fact that a certain tract of land is decided upon testimony to be mineral in character is by no means equivalent to an award of the land to a miner. A miner is compelled by law to give sixty days' publication of notice, and posting of diagrams and notices, as a preliminary step; and then, before he can enter the land, he must show that the land yields mineral; that he is entitled to the possessory right thereto in virtue of compliance with local customs or rules of miners, or by virtue of the statute of limitations; that he or his grantors have expended, in actual labor and improvements, an amount of not less than five hundred dollars thereon, and that the claim is one in regard to which there is no controversy or opposing claim. After all these proofs are met he is entitled to

have a survey made, at his own cost, where a survey is required, after which he can enter and pay for the land embraced by his claim.

112. Blank forms for proofs in mineral cases are not furnished by the General Land Office.

Respectfully,

N. C. McFARLAND, Commissioner.

DEPARTMENT OF INTERIOR, October 31, 1881.

Approved:

S. J. KIRKWOOD, Secretary.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., April 27, 1880.

Registers and Receivers, U. S. District Land Offices:

GENTLEMEN: Your attention is directed to the following copy of a letter from the Hon. Secretary of the Interior:

DEPARTMENT OF THE INTERIOR, WASHINGTON, April 22, 1880.

SIR: I have received your letter of the sixteenth instant, calling my attention to the withdrawals heretofore made of mineral lands under the direction of my predecessor, Hon. C. Delano, and setting forth at length the difficulties which arise in the adjustment of homestead and preëmption claims on account of said withdrawals, and recommending in view of such difficulties that the "present policy and practice of throwing the burden of proof upon agricultural claimants be reversed; that the applicant for such entry be required to make the non-mineral affidavit required as aforesaid, and that this be deemed sufficient in absence of the alleged mineral character of his claim; that if a party does allege in proper form that the land is valuable for minerals, he should be required to affirmatively prove the fact, instead of in every case, with or without such allegation, requiring every settler to prove an expensive negative."

You further recommend "that the withdrawals heretofore made as aforesaid be revoked, in order to remove the restriction upon *bona fide* agricultural settlements, and to place such lands in a condition where they can be occupied, purchased, and developed."

I have carefully considered the recommendations made by you for the reasons stated and have to say that they meet my approval.

You are therefore instructed to so modify the instructions of your office as to conform to said recommendations, and you are also instructed to revoke the orders of withdrawals mentioned by you, in order that the restrictions thereby made upon agricultural settlements of the lands may be removed.

Very respectfully,

C. SCHURZ, Secretary.

THE COMMISSIONER OF THE GENERAL LAND OFFICE.

The recommendations to the Hon. Secretary, upon which his said approval was based, are, in brief and in substance, that immense tracts of land are now, and, for several years last past, have been, officially designated as mineral lands; that as a matter of fact but an exceedingly small part of this entire area is valuable for minerals, but is good agricultural land; that these withdrawn lands are subject to entry under the homestead, preemption, and other laws providing for the sale of agricultural lands only after a hearing in every case wherein the burden of proof lies upon the agricultural applicant to establish that the tract claimed is non-mineral; that it is thus rendered exceedingly easy to cause such applicant great expense. delay, and vexation; that the expense, embarrassment, and delay actually incident to the course hitherto pursued operate to discourage and prevent settlements on such lands; that the timber on these lands is being largely taken on the claim that they are mineral lands; and that the vast tracts so designated, and which are capable of supporting many thousands of settlers, adding largely to the productions of the country and contributing to its better progress, are not only for the most part practically reserved

from sale under any law, but being so secluded it becomes easy for a party to fraudulently enter as agricultural a tract which he may discover to be valuable for minerals than for a *bona fide* settler to secure patent for agricultural land. All of such withdrawals heretofore made of lands in your district are hereby revoked; and when any party applies to enter any tract under any of the laws relating to agricultural lands, he will be required to make the usual non-mineral affidavit, which, in the absence of any allegation that the land is mineral, will be deemed sufficient. Should affidavits be filed with you properly alleging any tract sought to be entered as aforesaid to be mineral, you will, after due notice, hold a hearing to determine the facts. In such cases the burden of proof will rest upon the party who alleges the land to be valuable for minerals, and he must affirmatively prove his allegations.

It is expected that you will exercise all possible prudence and care in respect to this matter, and endeavor to carefully and conscientiously maintain and advance the purpose of the department and this office, to wit: to enable the public lands which are in fact agricultural to be occupied and purchased without oppressive conditions, and to prevent lands which are in fact valuable for minerals from being taken, except under the special laws applicable thereto.

Very respectfully,

J. A. WILLIAMSON, Commissioner.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFCE,
WASHINGTON, D. C., September 23, 1880.

Registers and Receivers, United States District Land Offices:

GENTLEMEN: Hereafter, in case of application being made in your office to enter or select, as agricultural land under any Act of Congress other than the preëmption or homestead Acts, lands returned as mineral by the Surveyor-General, you will require the applicant, at date of final proof, location, or selection, to publish for thirty days a notice describing the land applied for, and giving time and place when such proof will be submitted or selection tendered. You will also post in your office a copy of the notice for the same period. Proof of publication will consist of the affidavit of the publisher of the newspaper in which the notice was published, and you will furnish your own certificate as to posting in your office.

The revocation of the withdrawals of lands as mineral by circular of April 27, 1880, was made not only because said withdrawals had, in many instances, worked great hardship to settlers, but because it is required by law that homestead and preëmption claimants shall publish notices of their intention to make final proof on their entries, and this was thought to afford sufficient protection to all parties; but in case of entries under other laws there is no such notice required. This procedure will apply to cases of application to enter under the town site, desert land, and timber culture laws; applications to select lands under grants to States, railroad and wagon-road companies; and the location of the various classes of scrip upon lands which have been returned by the Surveyor-General as mineral in character.

Where, after such publication of notice has been regularly made, no affidavits alleging the mineral character of the land have been filed with you, you will allow the entry, selection, or location upon the filing of a

proper non-mineral affidavit. If such mineral affidavits shall have been filed, you will proceed with a hearing, as directed by the circular of April 27, 1880.

Acknowledge receipt hereof.

Very respectfully,

J. A. WILLIAMSON, Commissioner.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., May 9, 1882.

To Registers and Receivers, United States District Land Offices:

GENTLEMEN: Your attention is directed to the provisions of the following Act of Congress, approved April 26, 1882:

An Act to amend section twenty-three hundred and twenty-six of the Revised Statutes, in regard to mineral lands, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That the adverse claim required by section twenty-three hundred and twenty-six of the Revised Statutes may be verified by the oath of any duly authorized agent or attorney in fact of the adverse claimant cognizant of the facts stated; and the adverse claimant, if residing or at the time being beyond the limits of the district wherein the claim is situated, may make oath to the adverse claim before the Clerk of any Court of record of the United States or the State or Territory where the adverse claimant may then be, or before any Notary Public of such State or Territory.

SEC. 2. That applicants for mineral patents, if residing beyond the limits of the district wherein the claim is situated, may make any oath or affidavit required for proof of citizenship before the Clerk of any Court of record, or before any Notary Public of any State or Terrritory.

1. It will be observed that the Act is not retroactive, and hence cannot affect proceedings had prior to its approval; where citizenship, however, has not been proven, it may be established as provided by section two of this Act.

2. Where an agent or attorney in fact verifies the adverse claim, he must distinctly swear that he is such agent or attorney, and accompany his affidavit by proof thereof.

3. The agent or attorney in fact must make the affidavit in verification of the adverse claim within the land district where the claim is situated.

Very respectfully,

N. C. McFARLAND, Commissioner.

Department of Interior, May 26, 1882.
Approved:

H. M. TELLER, Secretary.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., September 22, 1882.

To Registers and Receivers, and Surveyors-General:

GENTLEMEN: The following regulations are promulgated as amendatory of circular of October 31, 1881, entitled "United States Mining Laws and Regulations Thereunder," and have special reference to applications for patents to placer claims. They are to be considered in connection with paragraphs fifty-three to sixty of regulations contained in said circular:

1. The first care in recognizing an application for patent upon a placer

claim must be exercised in determining the exact classification of the lands. To this end the clearest evidence of which the case is capable should be presented. If the claim be all placer ground, that fact must be stated in the application, and corroborated by accompanying proofs. If of mixed placers and lodes it should be so set out, with a description of all known lodes situated within the boundaries of the claim. A specific declaration, such as is required by Section 2333, Revised Statutes, must be furnished as to each lode intended to be claimed. All other known lodes are, by the silence of the applicant, excluded by law from all claim by him, of whatsoever nature, possessory or otherwise.

2. Section 2395, Revised Statutes (subdivision 7), requires the Surveyor to "note in his field books, the true situation of all mines, salt licks, salt springs, and mill seats which come to his knowledge;" also, all water-courses over which the lines he runs may pass." It further requires him to "note the quality of the lands." These descriptive notes are required by subdivision 8 to be incorporated in the plat by the Surveyor-General.

3. If these duties have been performed, the surveys will furnish a reasonable guide to the district officers, and to claimants in prosecuting their applications. But experience has shown that great neglect has resulted from inattention to the law in this respect, and the regular plats are of very little value in the matter. It will, therefore, be required in the future that Deputy Surveyors shall, at the expense of the parties, make full examination of all placer claims, and duly note the facts as specified in the law, stating the quality and composition of the soil, the kind and amount of timber and other vegetation, the locus and size of streams, and such other matters as may appear upon the surface of the claims. This examination should include the character and extent of all surface and underground workings, whether placer or lode, for mining purposes.

4. In addition to these data, which the law requires to be shown in all cases, the deputy should report with reference to the proximity of centers of trade or residence; also of well known systems of lode deposit or of individual lodes. He should also report as to the use or adaptability of the claim for placer mining; whether water has been brought upon it in sufficient quantity to mine the same, or whether it can be procured for that purpose; and finally, what works or expenditures have been made by the claimant or his grantors for the development of the claim, and their situation and location with respect to the same as applied for.

5. This examination should be reported by the deputy under oath to the Surveyor-General, and duly corroborated; and a copy of the same should be furnished with the application for patent to the claim, constituting a part thereof, and included in the oath of the applicant.

6. In case of a proposed claim for lands not yet surveyed, the foregoing regulations will govern the application for survey.

7. In controversies hereafter to be determined respecting the mineral value of lands, their value for all purposes, whether agricultural or municipal, or as seats for towns, will be considered, without reference to the decisions heretofore made in particular cases. No decision finally executed, however, will be reconsidered under this modification.

8. No application by an association of persons for patent to a placer claim will be allowed to embrace more than one hundred and sixty acres, nor will any application be entertained that embraces more than one location.

9. Applications awaiting entry, whether published or not, must be made to conform to these regulations, both with respect to amount of ground and examination as to the character of the land. Entries already made

will be suspended for examination by the Commissioner, and such additional proofs as may be deemed necessary in each case will be demanded.

Very respectfully,

N. C. McFARLAND, Commissioner.

Department of the Interior, September 23, 1882.

Approved:

H. M. TELLER, Secretary.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFCE,
WASHINGTON, D. C., December 9, 1882.

To Registers and Receivers, and Surveyors-General:

GENTLEMEN: By direction, contained in letter dated the seventh instant, from the honorable Secretary of the Interior, paragraph number eight, of the preceding circular of September 22, 1882, relating to placer mining claims, has been amended so as to read as follows:

8. No application by an association of persons for patent to a placer claim will be allowed to embrace more than one hundred and sixty acres; and not less than five hundred dollars' worth of work must be shown to have been expended upon or for the benefit of each separate location embraced in such application. If an individual becomes the purchaser and possessor of several separate claims of twenty acres each or less, he may be permitted to include in his application for patent any number of such claims contiguous to each other, not exceeding in the aggregate one hundred and sixty acres; but upon or for the benefit of each original claim or location so embraced, he or his grantors must have expended the sum of five hundred dollars in improvements.

You are instructed to observe this modification of my said circular of September 22, 1882.

Very respectfully,

N. C. McFARLAND, Commissioner.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., November 16, 1882.

To United States Surveyors-General:

GENTLEMEN: The regulations of this office require that the plats and field notes of surveys of mining claims shall disclose all conflicts between such surveys and prior surveys, giving the areas of conflicts.

The rule has not been properly observed in all cases. Your attention is invited to the following particulars which should be observed in the survey of every mining claim:

1. The exterior boundaries of the claim should be represented on the plat of survey and in the field notes.

2. The intersection of the lines of the survey with the lines of conflicting prior surveys should be noted in the field notes and represented upon the plat.

3. Conflicts with unsurveyed claims, where the applicant for survey does not claim the area in conflict, should be shown by actual survey.

4. The total area of the claim embraced by the exterior boundaries should be stated, and also the area in conflict with each intersecting survey, substantially as follows:

Total area of claim	10.50 acres.
Area in conflict with Survey No. 302	1.56 acres.
Area in conflict with Survey No. 948	2.33 acres.
Area in conflict with Mountain Maid lode mining claim, unsurveyed	1.48 acres.

In a number of instances that have come to the attention of this office the total area in conflict has been given, but not the area in conflict with *each* intersecting claim. The portion of the plat not in conflict has been colored, and the remainder left uncolored. The language of the field notes has been such as to convey the idea that the conflicting areas were excluded from the claim, whereas such was not the intention. It does not follow that because mining surveys are required to exhibit all conflicts with prior surveys the areas of conflict are to be excluded. The field notes and plat are made a part of the application for patent, and care should be taken that the description does not inadvertently exclude portions intended to be retained. It is better that the application for patent should state the portions to be excluded in express terms. A survey executed as in the example given will enable the applicant for patent to exclude such conflicts as may seem desirable. For instance, the conflict with Survey No. 302, and with the Mountain Maid lode claim, might be excluded, and that with Survey No. 948 included.

Your attention is also invited to another matter. The practice of coloring portions of surveys, leaving other portions uncolored, is open to the same objections that have been stated concerning the field notes. In the future no coloring will be used.

Very respectfully,

N. C. McFARLAND, Commissioner.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., June 8, 1883.

To Registers and Receivers and Surveyors-General:

GENTLEMEN: The following additional regulations are promulgated as amendatory of circular of October 31, 1881, entitled "United States Mining Laws and Regulations Thereunder," which, except as herein modified, will remain in full force:

1. No application will be received, or entry allowed, which embraces more than one lode location.

2. A party who is not an applicant for patent under Section 2325, Revised Statutes, or the assignee of such applicant, is not entitled to make entry under said section, and in no case will the name of such party be inserted in the certificate of entry. This regulation has no reference to proceedings under Section 2326.

3. Any party applying to make entry as *trustee* must disclose fully the nature of the trust, and the name of the *cestui que trust;* and such trustee, as well as the beneficiaries, must furnish satisfactory proof of citizenship; and the names of beneficiaries, as well as that of the trustee, must be inserted in the final certificate of entry.

4. Where an adverse claim has been filed and suit thereon commenced within the statutory period, and final judgment determining the right of possession rendered in favor of the applicant, it will not be sufficient for him to file with the Register a certificate of the Clerk of the Court setting forth the facts as to such judgment, but he must, before he is allowed to

make entry, file a certified copy of the judgment, together with the other evidence required by Section 2326, Revised Statutes.

5. Where such suit has been dismissed, a certificate of the Clerk of the Court to that effect, or a certified copy of the order of dismissal, will be sufficient.

6. In no case will a relinquishment of the ground in controversy, or other proof, filed with the Register or Receiver, be accepted in lieu of the evidence required in paragraphs 4 and 5.

7. Where an adverse claim has been filed, but no suit commenced against the applicant for patent within the statutory period, a certificate to that effect, by the Clerk of the State Court having jurisdiction in the case, and also by the Clerk of the Circuit Court of the United States for the district in which the claim is situated, will be required.

8. Possessory title to a lode claim held and worked for a period equal to the time prescribed by the statute of limitations for mining claims of the State or Territory where the same may be situated, may, in the absence of any adverse claim, be established in the same manner as now allowed in placer claims, and indicated generally in paragraphs 67, 68, and 69, of the circular hereby amended.

9. No entry will be allowed until the Register has satisfied himself, by a careful examination, that proper proofs have been filed upon all the points indicated in official regulations in force, and that they show a sufficient *bona fide* compliance with the laws and such regulations. A strict observance of this regulation will be required.

L. HARRISON, Acting Commissioner.

JULY 6, 1883.

Approved:

H. M. TELLER, Secretary.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., December 20, 1883.

Register and Receiver, Leadville, Colorado:

Where consolidated, application filed prior to receipt by you of circular of July 6, entry may be allowed on filing satisfactory proof of five hundred dollars' improvements on each lode claim, the application being otherwise regular.

L. HARRISON, Acting Commissioner.

Approved:

H. M. TELLER, Secretary.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., December 20, 1883.

To Register and Receiver, ——, ——:

GENTLEMEN: Inclosed find copy of telegraphic order this day approved by the honorable Secretary of the Interior. These instructions are intended to apply to all cases where an application for patent embracing more than one lode location had been filed prior to the receipt of circular "N" of this office, approved July 6, 1883.

In regard to similar cases in your office you will be governed by the rule therein stated.

Very respectfully,

L. HARRISON, Acting Commissioner.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., January 14, 1884.

Registers and Receivers:

GENTLEMEN: Your attention is called to the following extract from the decision of the honorable Secretary of the Interior, in case of Charles K. Miner, claimant of the Spencer Lode, *vs.* J. G. Marriott *et al.*, claimants of the Tabor Lode, dated January 4, 1884:

Section 2325 of the Revised Statutes requires, among other things, newspaper publication for the period of sixty days, as notice of application for mineral patent. It also provides that "if no adverse claim shall have been filed with the Register and Receiver of the proper Land Office at the expiration of the sixty days of publication, it shall be assumed that the applicant is entitled to a patent, upon the payment to the proper officer of five dollars per acre, and that no adverse claim exists."

Section 2326 prescribes the method of procedure "where an adverse claim is filed during the period of publication."

For the purpose of deciding the question raised by the appeal, it is only necessary to apply the provisions of law above cited to the facts relative to publication, as disclosed by the record.

These are found to be as follows: The first publication for the Tabor Lode was, as already stated, on the first of June, 1882. The adverse claim of Miner was filed on the third of August, 1882.

Excluding, in accordance with a long established rule of the Department, the first day, we find the third of August to be the sixty-third day of publication.

An apparently plain and simple proposition is thus presented for consideration.

The law requires that an adverse, to be effective, must be filed within the sixty days of publication. Miner's adverse claim was not filed until the sixty-third day. Was it filed within the period prescribed by the law, and has the adverse claimant a legal status as such?

This would admit of no discussion except for the following facts: This Department has held for a number of years (certainly since 1874) that where publication is made in a weekly newspaper, ten insertions are essential in order to show compliance with the law requiring sixty days' publication. In such cases the tenth issue falls on the sixty-third day after the first. In view of this ruling of the Department, your office, in October, 1879, promulgated a decision or order containing the following: "The last, or tenth, insertion being essential, it follows that adverse claims may be filed until the expiration of the day upon which the last issue of such weekly publication is made."

This rule has since been followed by your office, and you therefore recognize as legal and valid the adverse claim of Miner filed on the day of tenth issue of paper containing publication, *i. e.*, on the sixty-third day. In my opinion, the practice of your office referred to is not necessary as a logical result of the rule requiring ten insertions in a weekly paper, nor is it consistent with the law which prescribes the time within which an adverse claim may be filed.

Section 2325 of the Revised Statutes specifically fixes sixty days as the period of publication, and says "if no adverse claim shall have been filed * * * at the expiration of the *sixty days* of publication it shall be assumed that the applicant is entitled to a patent," etc. The regulation requiring ten publications (in a weekly paper), thus in fact making the period sixty-three days instead of sixty, does not alter the law as to sixty days for the filing of an adverse.

The regulation has its reason in the fact that in no other way can the law requiring sixty days' publication be complied with. Nine issues of a weekly paper would not cover the required period. It is true that the tenth insertion carries the publication three days beyond the legally required sixty days, yet, for the purpose of meeting the requirement of law, ten insertions are in fact necessary, since the continuity for sixty days can be preserved only by the tenth publication which falls on the sixty-third day after the first. It is also true that the applicant cannot proceed to complete his entry until after the tenth publication, but this is because it is essential as proof of sixty days' publication. These reasons do not apply to an adverse claimant, and his acts are not controlled thereby. He has the plain letter of the law for his guide. His course is clear and his duty plain. He has sixty days, on any one of which he may file his adverse claim.

If he fails to file within the sixty days of publication prescribed by the law he is barred. So far as he is concerned, the question is one of very simple computation.

It would be equally plain as to the applicant, except for the reasons herein given, and which do not control in considering the rights, either legal or equitable, of an adverse claimant.

*   *   *   *   *   *   *   *   *   *   *   *

So far as the case under consideration is concerned, however, your decision that the adverse claim was properly received, and therefore dismissing the appeal, is affirmed. The rule of this decision should not operate to interfere with or take away any rights acquired under the law, as it has heretofore been construed by your office. Though that construction is, in my opinion, clearly erroneous, such fact does not render illegal any acts which have been performed in accordance with and pursuant to that construction or interpretation. Until a rule is changed it has all the force of law, and acts done under it while it is in force must be regarded as legal. This view will govern you in the consideration of any similar cases which may arise.

After the receipt of this circular at your office, you will be required to observe strictly the above ruling of the Department.

Very respectfully,

N. C. McFARLAND, Commissioner.

N.

CIRCULAR.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., May 11, 1885.

To U. S. Surveyors-General and Registers and Receivers:

GENTLEMEN: Circular "N" of December 4, 1884, is hereby amended as follows:

1. In entries made prior to the receipt by the Register and Receiver of said circular the survey, if free from objection under the former practice, need not be amended to conform to the provisions of paragraph 2 of said circular.

2. All decisions under said circular in conflict with the foregoing amendment may, to that extent, be recalled.

Very respectfully,

WM. A. J. SPARKS, Commissioner.

Approved:

L. Q. C. LAMAR, Secretary.

N.

CIRCULAR.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., December 4, 1884.

To United States Surveyors-General and Registers and Receivers:

GENTLEMEN: 1. The rights granted to locators under Section 2322, Revised Statutes, are restricted to such locations on veins, lodes, or ledges as may be "situated on the *public domain.*" In applications for lode claims where the survey conflicts with a prior valid lode claim or entry, and the ground in conflict is excluded, the applicant not only has no right to the excluded ground, but he has no right to that portion of any vein or lode the top or apex of which lies within such excluded ground, unless his location was prior to May 10, 1872. His right to the lode claimed terminates where the lode, in its onward course or strike, intersects the exterior boundary of such excluded ground and passes within it.

2. The end-line of his survey should not, therefore, be established beyond such intersection, unless it should be necessary so to do for the purpose of including ground held and claimed under a location which was made upon public land and valid at the time it was made. To include such ground

(which may possibly embrace other lodes) the end-line of the survey may be established within the conflicting survey, but the line must be so run as not to extend any further into the conflicting survey than may be necessary to make such end-line parallel to the other end-line, and at the same time embrace the ground so held and claimed. The useless practice in such cases of extending *both* the side lines of a survey into the conflicting survey and establishing an end-line wholly within it, beyond a point necessary under the rule just stated, will be discontinued.

3. These instructions will be observed by Surveyors-General in all cases where surveys have not been approved by them prior to receipt hereof.

4. If, however, a survey under the old practice has been approved by the Surveyor-General prior to the receipt by him of these instructions application for patent thereon, if otherwise regular, will not be rejected.

5. In applications filed prior to receipt hereof at the local Land Office, and applications allowed under the preceding paragraph, entry will be allowed as heretofore, when the necessary proofs under former regulations are complete.

6. In case of applications and entries allowed under paragraphs four and five, amendment of the survey will be directed by this office, if found necessary.

7. After the receipt of this circular at the local Land Office all applications for mineral patents, applications to purchase, Register's final certificates of entry, and Receiver's receipts, must not only describe the ground claimed, but must state specifically what conflict or conflicts with other surveys, lots, or claims are excluded, giving the number of each conflicting survey or lot. The published and posted notices must contain the same information.

8. As this circular does not affect any rights which an applicant has under the law, its enforcement in pending cases cannot operate injuriously, and it will therefore be carried into effect at once in the adjudication of cases by this office. In the form of patents to be issued the same rule will go into operation as soon as the necessary blanks and records can be prepared.

9. A strict observance of these regulations will be required.

Very respectfully,

N. C. McFARLAND, Commissioner.

Approved:

H. M. TELLER, Secretary.

N. CIRCULAR.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., December 14, 1885.

To Registers and Receivers and Surveyors-General:

GENTLEMEN: 1. For reasons stated in decision dated October 31, 1885, in the case of the Good Return Placer Mine (4 L. D. 221), the Hon. Secretary of the Interior holds that the "circular instructions of ninth December, 1882, and the first requirement of the circular of eighth June, 1883, are erroneous, and the same are accordingly overruled."

2. Said decision also holds: That the annual expenditure to the amount of $100, required by Section 2324, Revised Statutes, must be made upon placer claims as well as lode claims.

3. That "compliance 'with the terms of this chapter,' as a condition

for the making of application for patent according to Section 2325, requires the preliminary showing of work or expenditure upon each location, sufficient to the maintenance of possession under Section 2324, either by showing the full amount for the pending year, or if there has been failure it should be shown that work has been resumed so as to prevent relocation by adverse parties after abandonment."

4. "That as Section 2325 only directs proof of expenditure to the amount of five hundred dollars by certificate of the Surveyor-General on the claim embraced in the application for patent, it must be error to hold that it further requires that amount on each individual original location, in lieu of the amount already provided for by Section 2324."

5. Registers will, therefore, before receiving any applications or permitting entry upon applications already made, require a satisfactory preliminary showing of work or expenditure, under paragraph 3 hereof, upon or for the benefit of each location embraced in the claim, which may, where the matter is unquestioned, consist of the affidavit of the applicant, clearly and specifically setting out all the *facts* constituting the compliance with the law by himself or grantors. Where application is made by an incorporated company, or where an applicant satisfactorily shows by affidavit that he is not personally acquainted with the facts, the applicant's affidavit may be made by the duly authorized agent who has such knowledge, but whether made by principal or agent it must be specifically and fully corroborated by the affidavits of at least two disinterested and credible witnesses familiar with the facts. This showing must include the year in which the application for patent is filed. The evidence specified in paragraph 32 of Circular N of October 31, 1881, will still be required. Where the abstract of title is dated prior to the date of filing the application for patent, a continuation of the abstract to and including such date must be filed before the applicant is allowed to make entry.

6. Where an application for patent embraces several locations or claims *held in common*, constituting one entire claim, whether lode or placer, an expenditure of five hundred dollars, under Section 2325, R. S., upon such entire claim embraced in the application, will be sufficient and need not be shown upon each of the locations included therein.

You will observe carefully the modification of the practice and regulations as above indicated.

WM. A. J. SPARKS, Commissioner.

Approved December 15, 1885:

L. Q. C. LAMAR, Secretary.

TIMBER AND STONE LANDS.

An Act for the Sale of Timber Lands in the States of California, Oregon, Nevada, and in Washington Territory. (Approved June 3, 1878. U. S. Stats., v. 20. p. 89.)

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That surveyed public lands of the United States, within the States of California, Oregon, and Nevada, and in Washington Territory, not included within military, Indian, or other reservations of the United States, valuable chiefly for timber, but unfit for cultivation, and which have not been offered at public sale, according to law, may be sold to citizens of the United States, or persons

who have declared their intention to become such, in quantities not exceeding one hundred and sixty acres to any one person, or association of persons, at the minimum price of two dollars and fifty cents per acre; and lands valuable chiefly for stone may be sold on the same terms as timber lands; *provided*, that nothing herein contained shall defeat or impair any bona fide claim under any law of the United States, or authorize the sale of any mining claim, or the improvements of any *bona fide* settler, or lands containing gold, silver, cinnabar, copper, or coal, or lands selected by the said States under any law of the United States donating lands for internal improvements, education, or other purposes; *and provided further*, that none of the rights conferred by the Act approved July twenty-sixth, eighteen hundred and sixty-six, entitled "An Act granting the right of way to ditch and canal owners over the public lands, and for other purposes," shall be abrogated by this Act; and all patents granted shall be subject to any vested and accrued water rights, or rights to ditches and reservoirs used in connection with such water rights as may have been acquired under and by the provisions of said Act; and such rights shall be expressly reserved in any patent issued under this Act.

SEC. 2. That any person desiring to avail himself of the provisions of this Act, shall file with the Register of the proper district a written statement in duplicate, one of which is to be transmitted to the General Land Office, designating, by legal subdivisions, the particular tract of land he desires to purchase, setting forth that the same is unfit for cultivation, and valuable chiefly for its timber or stone, that it is uninhabited, contains no mining or other improvements, except for ditch or canal purposes, where any such do exist, save such as were made by or belong to the applicant, nor, as deponent verily believes, any valuable deposit of gold, silver, cinnabar, copper, or coal; that deponent has made no other application under this Act; that he does not apply to purchase the same on speculation, but in good faith to appropriate it to his own exclusive use and benefit; and that he has not, directly or indirectly, made any agreement or contract, in any way or manner, with any person or persons whatsoever, by which the title which he might acquire from the Government of the United States should inure, in whole or in part, to the benefit of any person except himself; which statement must be verified by the oath of the applicant before the Register or the Receiver of the Land Office within the district where the land is situated; and if any person taking such oath shall swear falsely in the premises he shall be subject to all the pains and penalties of perjury, and shall forfeit the money which he may have paid for said lands, and all right and title to the same; and any grant or conveyance which he may have made, except in the hands of *bona fide* purchasers, shall be null and void.

SEC. 3. That upon the filing of said statement, as provided in the second section of this Act, the Register of the Land Office shall post a notice of such application, embracing a description of the land by legal subdivisions, in his office, for a period of sixty days, and shall furnish the applicant a copy of the same for publication, at the expense of such applicant, in a newspaper published nearest the location of the premises, for a like period of time; and after the expiration of said sixty days, if no adverse claim shall have been filed, the person desiring to purchase shall furnish to the Register of the Land Office satisfactory evidence: first, that said notice of the application prepared by the Register as aforesaid, was duly published in a newspaper as herein required; secondly, that the land is of the character contemplated in this Act, unoccupied and without improvements, other than those excepted, either mining or agricultural,

and that it apparently contains no valuable deposits of gold, silver, cinnabar, copper, or coal; and upon payment to the proper officer of the purchase money of said land, together with the fees of the Register and the Receiver, as provided for in case of mining claims in the twelfth section of the Act, approved May tenth, eighteen hundred and seventy-two, the applicant may be permitted to enter said tract, and, on the transmission of the General Land Office of the papers and testimony in the case, a patent shall issue thereon; *provided*, that any person having a valid claim to any portion of the land may object, in writing, to the issuance of a patent to lands so held by him, stating the nature of his claim thereto; and evidence shall be taken, and the merits of said objection shall be determined by the officers of the Land Office, subject to appeal, as in other land cases. Effect shall be given to the foregoing provisions of this Act by regulations to be prescribed by the Commissioner of the General Land Office.

Sec. 4. That after the passage of this Act it shall be unlawful to cut, or cause or procure to be cut, or wantonly destroy any timber growing on any lands of the United States, in said States and Territory, or remove, or cause to be removed, any timber from said public lands, with intent to export or dispose of the same; and no owner, master, or consignee of any vessel, or owner, director, or agent of any railroad, shall knowingly transport the same, or any lumber manufactured therefrom; and any person violating the provisions of this section shall be guilty of a misdemeanor, and, on conviction, shall be fined for every such offense a sum not less than one hundred nor more than one thousand dollars; *provided*, that nothing herein contained shall prevent any miner or agriculturist from clearing his land in the ordinary working of his mining claim, or preparing his farm for tillage, or from taking the timber necessary to support his improvements, or the taking of timber for the use of the United States; and the penalties herein provided shall not take effect until ninety days after the passage of this Act.

Sec. 5. That any person prosecuted in said States and Territory for violating section two thousand four hundred and sixty-one of the Revised Statutes of the United States, who is not prosecuted for cutting timber for export from the United States, may be relieved from further prosecution and liability therefor upon payment, into the Court wherein such action is pending, of the sum of two dollars and fifty cents per acre for all lands on which he shall have cut, or caused to be cut, timber, or removed, or caused to be removed, the same; *provided*, that nothing contained in this section shall be construed as granting to the person hereby relieved, the title to said lands for said payment; but he shall have the right to purchase the same upon the same terms and conditions as other persons, as provided hereinbefore in this Act; *and further provided*, that all moneys collected under this Act shall be covered into the Treasury of the United States, and section four thousand seven hundred and fifty-one of the Revised Statutes is hereby repealed, so far as it relates to the States and Territory herein named.

Sec. 6. That all Acts and parts of Acts inconsistent with the provisions of this Act are hereby repealed.

TO FIND THE VALUE OF GOLD OR SILVER OF A SPECIMEN.

(By C. H. Aaron.)

There are many rules for ascertaining the proportion of gold in specimens, all based on the different densities of the specimens as a whole, of the gold, and of the quartz. The specific gravity of the gold and of the quartz is generally assumed, the former at 17 to 19, the latter at 2.6. That of the specimen is found by weighing it in air and in water, and dividing its weight in air by the difference. In this case, the easiest rule to remember is this: Divide the specific gravity of the gold by that of the quartz and by that of the specimen. From the greater quotient subtract the lesser; the remainder is the proportion of gold. From the lesser quotient subtract 1; the remainder is the proportion of quartz. Then as the sum of these proportional quantities is to the proportion of gold, so is the weight of the specimen to the actual quantity of gold in it. Suppose a specimen weighs 32 ounces in air and 28 ounces in water; the difference is 4, and 32 divided by 4 gives 8, which is the specific gravity of the specimen. If the specific gravity of the gold is assumed to be 17, and that of the quartz 2.6, we have 17 divided by 2.6, gives 6.539 nearly, and 17 divided by 8 gives 2.125. Subtracting the lesser quotient from the greater leaves 4.414, and subtracting 1 from the lesser leaves 1.125, and the proportion is 4.414 ounces of gold to 1.125 of quartz. Adding these together we have 5.539. Now it is a mere question in the rule of three. If 5.539 ounces of the specimen contain 4.414 ounces of gold, how much does the whole specimen weighing 32 ounces contain? Answer, 25.5 ounces. This is correct provided the assumed specific gravities of the gold and gangue are correct; but if greater accuracy be desired, proceed thus: Weigh the specimen, a piece of the metal, and a piece of the gangue, each in air and water. Divide the difference between the respective weights in air and in water by the weights in air. From the greater quotient subtract the next less, and from that the least. The first remainder is the proportional weight of the metal, the second is that of the gangue; the sum of these is that of the specimen. Having the actual weight of the specimen, that of the metal is easily found, as before, by the rule of three.

Suppose a specimen of native silver in spar weighs 84 pounds in air and 73.5 in water; a piece of the silver weighs 27 grains in air and 24 in water; a piece of the spar 20 in air and 12 in water. Then—

Spar in air	20
Spar in water	12
Difference	$8 \div 20 = 0.400$.
Specimen in air	84
Specimen in water	73.5
Difference	$10.5 \div 84 = 0.125$.

Silver in air	27
Silver in water	24
Difference	$3 \div 27 = 0.111$.

And $400-125= 275$=proportion of silver.
And $125-111= 14$=proportion of spar.

289=proportion of specimen.

Then 289:275::84:79.93 pounds of silver in specimen.

The weight of the object in air divided by its difference in water is the specific gravity. The difference divided by the weight in air is the specific displacement. From either of these, the proportional quantities of two different substances composing a mixture can be determined by the rules given for the valuation of specimens.

TABLES.

The following tables and figures are taken from "Practical Hydraulics," by P. M. Randall:

QUANTITY OF WATER REQUIRED FOR QUARTZ MINING.

The contents of one ton of quartz, in its normal condition in the lode, is estimated at 13 cubic feet, and at 20 cubic feet when the quartz is broken, as it usually comes from the mine. Adopting the lode measurement, it is seen that a cubic yard of quartz is $27 \div 13 = 2.08$ tons, nearly. Experience shows that the duty of a miner's inch is as follows: Duty of a miner's inch (under 4-inch pressure) in the reduction and amalgamation of silver ores in a "stamp silver mill," Nevada, 3.25 cubic yards, or 6.76 tons; in the reduction and amalgamation by riffles, or copper plate, in "stamp gold mill," California, 5.78 cubic yards, or 12 tons. Duty of miner's inch under 7-inch pressure, in the former case (silver), 4.3 cubic yards, or 8.93 tons; in the latter case (gold), 6.65 cubic yards, or 15.88 tons. The volume of water to that of ore is, in working silver ores, Nevada, 19.5 to 1; in working gold ores, California, 11.1 to 1; in working copper ores, Lake Superior, 20 to 1.

MEASUREMENT OF THE POWER OF WATER AS A MOTOR.

The unit in the measurement of power is a foot-pound—that is, the amount of energy necessary to raise one pound weight vertically through a distance of one foot. On the other hand, one pound falling by the force of gravity through a distance of one foot, generates a foot-pound. The amount of energy required to raise one pound vertically 550 feet, is equal to the amount of energy necessary to raise 550 pounds vertically one foot in height. This amount of energy rendered in one second is termed a horse-power—that is, 550 foot-pounds rendered in one second, is the value of a horse-power in mechanics.

The weight of a cubic foot of fresh water is estimated in practice at 62.5 pounds. Ex.—How many horse-power will 10 cubic feet of water, applied to an overshot water wheel, 40 feet diameter, render, the efficiency of the wheel being 75 per cent, and one foot being allowed for clearance? Cal.—$40-1=39$ feet, effective head; $62.5 \times 10 \times 39 \times .75 \div 550 = 33.24$ horse-power. Ans.

MISCELLANIES.

One cubic foot of distilled water (U. S. standard), barometer 30 inches, 39.83° Fahr., equals 62.3793 pounds.

One cubic foot of distilled water (British standard), barometer 30 inches, 62° Fahr., equals 62.321 pounds.

One cubic foot of distilled water (U. S. standard), equals 7.48052 gallons.

One cubic inch of distilled water (U. S. standard), equals 0.0361 pounds.

One gallon (U. S. standard), equals 231 cubic inches, equals 0.133681 cubic feet, equals 8.3389 pounds water.

One gallon, imperial (British standard), equals 277.123 cubic inches, equals 0.160372 cubic feet, equal 10 pounds water.

One gallon (N. Y. statute measure), barometer 30 inches, 39.83° Fahr., equals 221.184 cubic inches, equals 8 pounds water.

One pound avoirdupois equals 16 ounces, equals 7,000 grains (U. S. standard), equals 27.7015 cubic inches.

One pound troy equals 1 pound apothecary, equals 12 ounces, equals 5,760 grains.

One ounce avoirdupois equals 437.5 grains.

One ounce troy equals one ounce apothecary, equals 480 grains.

One chain equals 100 links, equals 4 rods, equals 66 feet, equals 792 inches.

Eighty chains equal 1 statute mile, equals 320 rods, equals 1,760 yards, equals 5,280 feet, equals 63,260 inches.

One geographical, nautical, or sea mile equals 6,086.5 feet in longitude, and 6,076.5 feet in latitude.

One league (English), equals 3 nautical miles.

One metre equals 3.2808992 feet, equals 3.281 feet in practice.

One square metre equals 1 centiare, equals 10.7643 square feet.

One are equals 100 square meters, equals 1076.43 square feet.

One cubic meter equals 1 stare, equals 35.3166 cubic feet.

One vara equals 2.75 feet.

One legua (Mexican) equals 5,000 varas linear, equals 13,750 feet, equals 2.60417 miles.

One hundred vara lot equals 100 varas square, equals 75,625 square feet, equals 1.73611 acres.

One legua (Mexican, of land) equals 6.7817 square miles, equals 4340.-27778 acres.

One acre equals 4 roods, equals 10 square chains, equals 160 square rods, equals 43,560 square feet.

One section equals 1 square mile, equals 640 acres.

One township equals 36 sections, equals 6 miles square, equals 36 square miles.

One cubic yard equals 27 cubic feet, equals 16,656 cubic inches.

One hundred weight (British) equals 8 stone, equals 112 pounds.

One ton (long ton) commercial, equals 20-hundred weight, equals 2240 pounds.

One ton (short ton) U. S., equals 2000 pounds.

One quintal equals 100 pounds.

One fathom equals 6 feet; 1 cable length equals 120 fathoms.

One point equals $\frac{1}{72}$ of an inch.

One line equals 6 points, equals $\frac{1}{12}$ of an inch.

Twelve inches equals 1 foot; 3 feet equals 1 yard.

Five and one half yards equals 1 rod.

One foot board measure equals 1 foot square and 1 inch thick.

Twelve feet board measure equals 1 cubic foot.

One foot-pound equals work required to raise one pound vertically one foot.

One second foot-pound equals work required to raise one pound vertically one foot in one second of time.

One minute foot-pound equals work required to raise one pound vertically one foot in one minute.

One degree (1°), centigrade, equals 1.8° (degrees), Fahrenheit.

One barometric inch equals column of mercury, with one square inch base and one inch high.

Atmospheric pressure per square inch equals 14.7 pounds equals 30 barometric inches nearly, at 39.83° Fahr.

One ounce Troy, gold, 1,000 fine, equals $20.6718.

One ounce Troy, gold coin, U. S., 900 fine, equals $18.6046.

One pound avoirdupois, gold coin, U. S., 900 fine, equals $271.375.

One ounce Troy, silver, 1,000 fine, equals $1.29293.*

One ounce Troy, silver, U. S., 900 fine, equals $1.163636.*

One pound avoirdupois, silver coin, U. S., 900 fine, equals $16.96969.

One dollar, U. S. gold coin, equals 23.22 grains gold × 2.58 grains copper, equals 25.8 grains.

One dollar, U. S. silver coin, equals 371.25 grains silver × 41.25 grains copper, equals 412.5 grains.

One pound sterling equals 1 sovereign, equals 113.001 grains gold × 10.273 grains copper, equals 123.274 grains weight, fineness 22 carats, equals 916.6667.

One grain gold, 1,000 fine, equals $.0430663, mint value.

One grain silver, 1,000 fine, equals $.0026936, mint value.

One gramme gold, 1,000 fine, equals $.6646142, mint value.

One gramme silver, 1,000 fine, equals $.0415686, mint value.

One cubic foot air equals .0806726 pounds, equals 564.7082 grains.

One pound of air at 39.83° equals 12.387 cubic feet by volume.

One cubic foot hydrogen equals .005042 pounds, equals 35.2743 grains.

Twenty-five cubic feet of sand equals 1 ton.

Eighteen cubic feet of earth equals 1 ton.

Seventeen cubic feet of clay equals 1 ton.

Thirteen cubic feet of quartz, unbroken in lode, equals 1 ton.

Eighteen cubic feet of gravel or earth, before digging, equals 27 cubic feet when dug.

Twenty cubic feet of quartz, broken (of ordinary fineness, coming from the lode), equals 1 ton, contract measurement.

One horse-power (H. P.) equals 550 second foot-pounds, equal 33,000 minute foot-pounds.

One hundred libras (Mexico) = 1 quintal = 46,025.00 grammes = 101.5 pounds avoirdupois.

Avoirdupois Ounces to Troy Ounces.

Avoirdupois Ounces.	Troy Ounces.	Avoirdupois Ounces.	Troy Ounces.	Avoirdupois Ounces.	Troy Ounces.
1	0.911	7	6.380	13	11.849
2	1.823	8	7.292	14	12.760
3	2.734	9	8.203	15	13.672
4	3.646	10	9.115	16	14.583
5	4.557	11	10 026		
6	5.469	12	10.397		

437.5 grains equals 1 avoirdupois ounce.
480 grains equals 1 troy ounce.

*Subject to discount.

Avoirdupois Pounds to Troy Ounces.

Pounds.	Ounces.	Pounds.	Ounces.	Pounds.	Ounces.
1	14.583	10	145.833	100	1458.333
2	29.167	20	291.667	200	2916.667
3	43.750	30	437.500	300	4375.000
4	58.333	40	583.333	400	5833.333
5	72.917	50	729.167	500	7291.667
6	87.500	60	875.000	600	8750.000
7	102.083	70	1020.833	700	10208.333
8	116.667	80	1166.667	800	11666.667
9	131.250	90	1312.500	900	13125.000

Table Showing the Melting Points of Metals.

Metal.	Centigrade.	Fahrenheit.	Metal.	Centigrade.	Fahrenheit.
Aluminium	700°	1292°	Iron, steel	1400°	2552°
Antimony	425°	797°	Lead	334°	617°
Arsenic	185°	365°	Magnesium	235°	455°
Bismuth	264°	507.°2	Mercury	— 40°	*654.°8
Cadmium	320°	608°	Nickel	1600°	2912°
Cobalt	1200°	2192°	Potassium	62°	143.°6
Copper	1091°	1995.°8	Platinum	2600°	4712°
Gold	1381°	2485.°8	Silver	1040°	1904°
Indium	176°	348.°8	Sodium	96°	172.°8
Iron, wrought	1530°	2786°	Tin	235°	455°
Iron, cast	1200°	2192°	Zinc	412°	773.°6

Amalgams.

Gold—One weight of mercury amalgamates with two weights of gold.
Silver—10 silver to 19 mercury.
Tin—1 tin to 3 mercury, for looking-glasses.
1 tin, 1 lead, 2 bismuth, 10 mercury, for glass globes.
1 tin, 1 zinc, 3 mercury, for rubbers in electric machines.

Metrical System. Measures of Length.

	In Inches.	In Feet.	In Yards.	In Fathoms.	In Miles.
Millimetre	.03937	.003281	.0010936	.0005468	.0000006
Centimetre	.39371	.032809	.0109363	.0056482	.0000062
Decimetre	3.93708	.328090	.1093633	.0546816	.0000621
Metre	39.37079	3.280899	1.0936331	.5468165	.0006214
Decametre	393.70790	32.808992	10.9363306	5.4681653	.0062138
Hectometre	3937.07900	328.089917	109.3633056	54.6816528	.0621382
Kilometre	39370.7900	3280.899167	1093.6330556	546.8165278	.6213824
Myriametre	393707.9000	32808.991667	10936.3305556	5468.1652778	6.2138242

1 inch equals 2.539954 centimetres.
1 foot equals 3.0479449 decimetres.
1 yard equals 0.9143835 metre.
1 mile equals 1.06093149 kilometre.

* Boils.

Measures of Surface.

	In Square Feet.	In Square Yards.	In Poles.	In Roods.	In Acres.
Centiare, square metre	10.764299	1.196033	.0395383	.0009885	.0002471
Are, 100 square metres	1076.429934	119.603326	3.9538290	.0988457	.0247114
Hectare, 10,000 square metres	107642.993419	11960.332602	395.3828959	9.8845724	2.4711431

1 square inch equals 6.4514669 square centimetres.
1 square foot equals 9.2899683 square decimetres.
1 square yard equals .83609715 square metre.
1 acre equals .40467102 hectare.
1 square mile equals 2.58989451 hectares.

Measures of Capacity.

	In Cubic Inches.	In Cubic Feet.	In Pints.	In Gallons.	In Bushels.
Millilitre cubic centimetres	.06103	.000035	.00176	.0002201	.0000275
Litre or cubic decimetre	61.02705	.035317	1.76077	.2200967	.0275121

1 cubic inch equals 16.386176 cubic centimetres.
1 cubic foot equals 28.315312 cubic decimetres.
1 gallon equals 4.543458 litres.

Measures of Weights.

	In Grains.	In Troy Ounces.	In Avoirdupois Pounds.	In Cwts.	In Tons.
Milligram	.01543	.000032	.0000022	.0000000	.0000000
Centigram	.15432	.000322	.0000220	.0000002	.0000000
Decigram	1.54323	.003215	.0002205	.0000020	.0000001
Gram	15.43235	.032151	.0022046	.0000197	.0000010

1 grain equals .064799 gram.
1 pound avoirdupois equals .453593 kilogram.
1 troy ounce equals 31.103496 grams.
1 cwt. equals 50.802377 kilograms.

CHAPTER IV, PART II, TITLE III, POLITICAL CODE OF THE STATE OF CALIFORNIA.

LEGAL DISTANCES IN THE STATE.

150. *Legal Distances.*

Sec. 150. The legal distances in this State are fixed as follows:

151. *Alameda.*

Sec. 151. From the county seat of Alameda County to Sacramento, ninety-one (91) miles; to Napa, forty-six (46) miles; to Stockton, eighty-five (85) miles; to San Quentin, nineteen (19) miles.

152. *Alpine.*

Sec. 152. From the county seat of Alpine County to Sacramento, two hundred and twenty-five (225) miles; to Napa, two hundred and eighty-six (286) miles; to Stockton, two hundred and seventy-three (273) miles; to San Quentin, three hundred and twenty-one (321) miles.

153. *Amador.*

Sec. 153. From the county seat of Amador County to Sacramento, fifty-nine (59) miles; to Napa, one hundred and ten (110) miles; to Stockton, fifty-seven (57) miles; to San Quentin, one hundred and forty-five (145) miles.

154. *Butte.*

Sec. 154. From the county seat of Butte County to Sacramento, seventy-eight (78) miles; to Napa, one hundred and thirty-nine (139) miles; to Stockton, one hundred and twenty-six (126) miles; to San Quentin, one hundred and seventy-four (174) miles.

155. *Calaveras.*

Sec. 155. From the county seat of Calaveras County to Sacramento, seventy-three (73) miles; to Napa, one hundred and thirty-four (134) miles; to Stockton, sixty (60) miles; to San Quentin, one hundred and sixty-four (164) miles.

156. *Colusa.*

Sec. 156. From the county seat of Colusa County to Sacramento, eighty (80) miles; to Napa, one hundred and forty-one (141) miles; to Stockton, one hundred and twenty-eight (128) miles; to San Quentin, one hundred and seventy-six (176) miles.

157. *Contra Costa.*

Sec. 157. From the county seat of Contra Costa County to Sacramento,

eighty-nine (89) miles; to Napa, twenty-seven (27) miles; to Stockton, one hundred and twenty-one (121) miles; to San Quentin, forty-one (41) miles.

[Amendment approved March 14, 1878; amendments 1877–1878; in force from passage.]

158. *Del Norte.*

Sec. 158. From the county seat of Del Norte County to Sacramento, three hundred and sixty-four (364) miles; to Napa, three hundred and nineteen (319) miles; to Stockton, three hundred and seventy-two (372) miles; to San Quentin, two hundred and ninety-two (292) miles.

159. *El Dorado.*

Sec. 159. From the county seat of El Dorado County to Sacramento, sixty-one (61) miles; to Napa, one hundred and twenty-two (122) miles; to Stockton, one hundred and nine (109) miles; to San Quentin, one hundred and fifty-seven (157) miles.

160. *Fresno.*

Sec. 160. From the county seat of Fresno County to Sacramento, one hundred and sixty-nine (169) miles; to Napa, two hundred and thirty (230) miles; to Stockton, one hundred and thirteen (113) miles; to San Quentin, two hundred and seven (207) miles.

161. *Humboldt.*

Sec. 161. From the county seat of Humboldt County to Sacramento, three hundred and twelve (312) miles; to Napa, two hundred and sixty-seven (267) miles; to Stockton, three hundred and twenty (320) miles; to San Quentin, two hundred and forty (240) miles.

162. *Inyo.*

Sec. 162. From the county seat of Inyo County to Sacramento, four hundred and seventy-one (471) miles; to Napa, five hundred and thirty-two (532) miles; to Stockton, four hundred and twenty-three (423) miles; to San Quentin, five hundred and eight (508) miles.

163. *Kern.*

Sec. 163. From the county seat of Kern County to Sacramento, two hundred and seventy-eight (278) miles; to Napa, three hundred and thirty-nine (339) miles; to Stockton, two hundred and thirty (230) miles; to San Quentin, three hundred and fifteen (315) miles.

164. *Lake.*

Sec. 164. From the county seat of Lake County to Sacramento, two hundred and four (204) miles; to Napa, one hundred and fifty-nine (159) miles; to Stockton, two hundred and twelve (212) miles; to San Quentin, one hundred and thirty-two (132) miles.

165. *Lassen.*

Sec. 165. From the county seat of Lassen County to Sacramento, one hundred and eighty-three (183) miles; to Napa, two hundred and forty-

four (244) miles; to Stockton, two hundred and thirty-one (231) miles: to San Quentin, two hundred and seventy-nine (279) miles.

166. *Los Angeles.*

Sec. 166. From the county seat of Los Angeles County to Sacramento, four hundred and seventy-eight (478) miles; to Napa, four hundred and thirty-three (433) miles; to Stockton, four hundred and eighty-six (486) miles; to San Quentin, four hundred and six (406) miles.

167. *Marin.*

Sec. 167. From the county seat of Marin County to Sacramento, ninety-six (96) miles; to Napa, fifty-one (51) miles; to Stockton. one hundred and four (104) miles; to San Quentin, three (3) miles.

168. *Mariposa.*

Sec. 168. From the county seat of Mariposa County to Sacramento, one hundred and fifty-six (156) miles; to Napa, two hundred and seventeen (217) miles; to Stockton, one hundred and nine (109) miles; to San Quentin, one hundred and ninety-three (193) miles.

169. *Mendocino.*

Sec. 169. From the county seat of Mendocino County to Sacramento, two hundred and five (205) miles; to Napa, one hundred (100) miles; to Stockton, two hundred and thirteen (213) miles; to San Quentin, one hundred and thirty-three (133) miles.

170. *Merced.*

Sec. 170. From the county seat of Merced County to Sacramento, one hundred and fourteen (114) miles; to Napa, one hundred and seventy-five (175) miles; to Stockton, sixty-six (66) miles; to San Quentin, one hundred and fifty-two (152) miles.

171. *Modoc.*

Sec. 171. From the county seat of Modoc County to Sacramento, three hundred and seventy-nine (379) miles; to Napa, four hundred and forty (440) miles; to Stockton, four hundred and twenty-seven (427) miles; to San Quentin, four hundred and seventy-five (475) miles.

172. *Mono.*

Sec. 172. From the county seat of Mono County to Sacramento, two hundred and ninety-six (296) miles; to Napa, three hundred and fifty-seven (357) miles; to Stockton, three hundred and forty-four (344) miles; to San Quentin, three hundred and ninety-two (392) miles.

173. *Monterey.*

Sec. 173. From the county seat of Monterey County to Sacramento, one hundred and ninety-six (196) miles; to Napa, one hundred and fifty-seven (157) miles; to Stockton, one hundred and forty-eight (148) miles; to San Quentin, one hundred and thirty (130) miles.

174. *Napa.*

Sec. 174. From the county seat of Napa County to Sacramento, sixty-one (61) miles; to Stockton, eighty-seven (87) miles; to San Quentin, fifty-one (51) miles.

175. *Nevada.*

Sec. 175. From the county seat of Nevada County to Sacramento, seventy-one (71) miles; to Napa, one hundred and thirty-two (132) miles; to Stockton, one hundred and nineteen (119) miles; to San Quentin, one hundred and sixty-seven (167) miles.

176. *Placer.*

Sec. 176. From the county seat of Placer County to Sacramento, thirty-seven (37) miles; to Napa, ninety-eight (98) miles; to Stockton, eighty-five (85) miles; to San Quentin, one hundred and thirty-three (133) miles.

177. *Plumas.*

Sec. 177. From the county seat of Plumas County to Sacramento, one hundred and thirty-six (136) miles; to Napa, one hundred and ninety-seven (197) miles; to Stockton, one hundred and eighty-four (184) miles; to San Quentin, two hundred and thirty-two (232) miles.

178. *Sacramento.*

Sec. 178. From the county seat of Sacramento County to Napa, sixty-one (61) miles; to Stockton, forty-eight (48) miles; to San Quentin, ninety-six (96) miles.

179. *San Benito.*

Sec. 179. From the county seat of San Benito County to Sacramento, one hundred and seventy-three (173) miles; to Napa, one hundred and thirty-four (134) miles; to Stockton, one hundred and twenty-five (125) miles; to San Quentin, one hundred and seven (107) miles.

180. *San Bernardino.*

Sec. 180. From the county seat of San Bernardino County to Sacramento, five hundred and eighty-eight (588) miles; to Napa, five hundred and forty-three (543) miles; to Stockton, five hundred and thirty (530) miles; to San Quentin, five hundred and sixteen (516) miles.

181. *San Diego.*

Sec. 181. From the county seat of San Diego County to Sacramento, five hundred and sixty-six (566) miles; to Napa, five hundred and twenty-one (521) miles; to Stockton, five hundred and seventy-four (574) miles; to San Quentin, four hundred and ninety-four (494) miles. [Amendment, approved March 27, 1878. Amendments, 1877–8; in full force from passage.]

182. *San Francisco.*

Sec. 182. From the county seat of San Francisco County to Sacramento, eighty-four (84) miles; to Napa, thirty-nine (39) miles; to Stockton, ninety-two (92) miles; to San Quentin, twelve (12) miles.

183. *San Joaquin.*

SEC. 183. From the county seat of San Joaquin County to Sacramento, forty-eight (48) miles; to Napa, eighty-seven (87) miles; to San Quentin, one hundred and four (104) miles.

184. *San Luis Obispo.*

SEC. 184. From the county seat of San Luis Obispo County to Sacramento, two hundred and ninety-three (293) miles; to Napa, two hundred and forty-eight (248) miles; to Stockton, two hundred and eighty-seven (287) miles; to San Quentin, two hundred and twenty-one (221) miles.

185. *San Mateo.*

SEC. 185. From the county seat of San Mateo County to Sacramento, one hundred and five (105) miles; to Napa, sixty (60) miles; to Stockton, one hundred and thirteen (113) miles; to San Quentin, thirty-three (33) miles.

186. *Santa Barbara.*

SEC. 186. From the county seat of Santa Barbara County to Sacramento, three hundred and sixty-nine (369) miles; to Napa, three hundred and twenty-four (324) miles; to Stockton, three hundred and seventy-seven (377) miles; to San Quentin, two hundred and ninety-seven (297) miles.

187. *Santa Clara.*

SEC. 187. From the county seat of Santa Clara County to Sacramento, one hundred and twenty-eight (128) miles; to Napa, eighty-nine (89) miles; to Stockton, eighty (80) miles; to San Quentin, sixty-two (62) miles.

188. *Santa Cruz.*

SEC. 188. From the county seat of Santa Cruz County to Sacramento, two hundred and five (205) miles; to Napa, one hundred and sixty (160) miles; to Stockton, one hundred and fifty-one (151) miles; to San Quentin, one hundred and thirty-three (133) miles.

189. *Shasta.*

SEC. 189. From the county seat of Shasta County to Sacramento, one hundred and seventy-seven (177) miles; to Napa, two hundred and thirty-eight (238) miles; to Stockton, two hundred and twenty-five (225) miles; to San Quentin, two hundred and seventy-three (273) miles.

190. *Sierra.*

SEC. 190. From the county seat of Sierra County to Sacramento, one hundred and nineteen (119) miles; to Napa, one hundred and seventy (170) miles; to Stockton, one hundred and sixty-seven (167) miles; to San Quentin, two hundred and fifteen (215) miles.

191. *Siskiyou.*

SEC. 191. From the county seat of Siskiyou County to Sacramento, two hundred and eighty-five (285) miles; to Napa, three hundred and forty-six

(346) miles; to Stockton, three hundred and thirty-three (333) miles; to San Quentin, three hundred and seventy-one (371) miles.

192. *Solano.*

Sec. 192. From the county seat of Solano County to Sacramento, forty (40) miles; to Napa, twenty-one (21) miles; to Stockton, eighty-eight (88) miles; to San Quentin, fifty-six (56) miles.

193. *Sonoma.*

Sec. 193. From the county seat of Sonoma County to Sacramento, one hundred and forty-one (141) miles; to Napa, thirty-five (35) miles; to Stockton, one hundred and forty-nine (149) miles; to San Quentin, sixty-nine (69) miles.

194. *Stanislaus.*

Sec. 194. From the county seat of Stanislaus County to Sacramento, seventy-seven (77) miles; to Napa, one hundred and thirty-eight (138) miles; to Stockton, thirty (30) miles; to San Quentin, one hundred and fourteen (114) miles.

195. *Sutter.*

Sec. 195. From the county seat of Sutter County to Sacramento, fifty (50) miles; to Napa, one hundred and eleven (111) miles; to Stockton, ninety-eight (98) miles; to San Quentin, one hundred and forty-six (146) miles.

196. *Tehama.*

Sec. 196. From the county seat of Tehama County to Sacramento, one hundred and thirty-five (135) miles; to Napa, one hundred and ninety-six (196) miles; to Stockton, one hundred and eighty-three (183) miles; to San Quentin, two hundred and thirty-one (231) miles.

197. *Trinity.*

Sec. 197. From the county seat of Trinity County to Sacramento, two hundred and seventeen (217) miles; to Napa, two hundred and seventy-eight (278) miles; to Stockton, two hundred and sixty-five (265) miles; to San Quentin, three hundred and thirteen (313) miles.

198. *Tulare.*

Sec. 198. From the county seat of Tulare County to Sacramento, two hundred and eleven (211) miles; to Napa, two hundred and seventy-two (272) miles; to Stockton, one hundred and sixty-three (163) miles; to San Quentin, two hundred and forty-nine (249) miles.

199. *Tuolumne.*

Sec. 199. From the county seat of Tuolumne County to Sacramento, one hundred (100) miles; to Napa, one hundred and sixty-one (161) miles; to Stockton, sixty-six (66) miles; to San Quentin, one hundred and sixty-six (166) miles. [Amendment, approved February 15, 1878. Amendments 1877–78, took effect sixtieth day after passage.]

200. *Ventura.*

Sec. 200. From the county seat of Ventura County to Sacramento,

three hundred and ninety-two (392) miles; to Napa, three hundred and forty-seven (347) miles; to Stockton, four hundred (400) miles; to San Quentin, three hundred and twenty (320) miles.

201. *Yolo.*

Sec. 201. From the county seat of Yolo County to Sacramento, twenty (20) miles; to Napa, forty-one (41) miles; to Stockton, sixty-eight (68) miles; to San Quentin, ninety-two (92) miles.

202. *Yuba.*

Sec. 202. From the county seat of Yuba County to Sacramento, fifty-two (52) miles; to Napa, one hundred and thirteen (113) miles; to Stockton, one hundred (100) miles; to San Quentin, one hundred and forty-six (146) miles.

ROUTES OF TRAVEL, MODES OF CONVEYANCE, DISTANCES, ETC., FROM SAN FRANCISCO.

[Compiled from the Railroad Gazetteer.]

ABBREVIATIONS.

a Southern Pacific Company, station foot of Market Street.
b Southern Pacific Company, station Fourth and Townsend Streets.
C. & C.—Carson & Colorado Railroad.
C. N.—California Northern Railroad.
C. S.—California Southern Railroad.
N. C.—Nevada County Narrow Gauge Railroad.
N. & C.—Nevada and California Railroad.
N. P.—Northern Pacific Railroad.
N. P. C.—North Pacific Coast Railroad.
O. & C.—Oregon and California Railroad.
P. C. Ry.—Pacific Coast Railway.
P. M.—Pacific Mail Steamship Company.
P. C.—Pacific Coast Steamship Company.
S. J. & S. N.—San Joaquin and Sierra Nevada Railroad.
S. & P.—Sacramento and Placerville Railroad.
S. F. & N. P.—San Francisco and North Pacific Railroad.
S. P. C.—South Pacific Coast Railroad.
Stmr.—River Steamer.
S. V.—Sonoma Valley Railroad.
U. P.—Union Pacific Railroad.
V. V. & C. L.—Vaca Valley and Clear Lake Railroad.

CALIFORNIA.

Acampo, San Joaquin County.—*a* 107 miles.

Acton, Los Angeles County.—*a* 427 miles.

Adin, Modoc County.—*a* to Redding, 234 miles; stage, 124 miles.

Ætna Hot Springs, Napa County.—*a* to St. Helena, 64 miles; stage, 15 miles.

Agnews, Santa Clara County.—S. P. C., 40 miles.

Alameda, Alameda County.—*a* 11 miles; or S. P. C., 10 miles.

Albion, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 65 miles; or N. P. C. to Duncan Mills, 79 miles; stage, 89 miles; or P. C.

Alder Point, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 127 miles.

Alderneys, Marin County.—N. P. C., 24 miles.

Alder Creek, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 19 miles.

Alila, Tulare County.—*a* 274 miles.

Alleghany, Sierra County.—*a* to Marysville, 142 miles; stage, 60 miles; or *a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 40 miles.

Allens, Shasta County.—*a* to Redding, 234 miles; stage, 22 miles.

Allens Springs, Lake County.—*a* to Williams, 125 miles; stage, 42 miles.

Alma, Santa Clara County.—S. P. C., 58 miles; or *b* to Santa Clara, 47 miles; S. P. C., 15 miles.

Alpine, Los Angeles County.—*a* 417 miles.

Altamont, Alameda County.—*a* 56 miles.

Alta, Placer County.—*a* 158 miles.

Altaville, Calaveras County.—*a* to Milton, 122 miles; stage, 22 miles.

Alturas (Dorris Bridge), Modoc County.—*a* to Redding, 234 miles; stage, 165 miles.

Alvarado, Alameda County.—S. P. C., 24 miles.

Alviso, Santa Clara County.—S. P. C., 38 miles.

Alvord, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C., 239 miles.

Amador City, Amador County.—*a* to Ione, 140 miles; stage, 14 miles.

Amboy, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 156 miles.

Anaheim, Los Angeles County.—*a* 509 miles, or P. C. to Anaheim Landing, 396 miles; stage, 13 miles.

Anderson, Shasta County.—*a* 223 miles.

Anderson Springs, Lake County.—*a* to Calistoga, 73 miles; stage, 18 miles, to Middleton; private conveyance, 3 miles.

Angels, Calaveras County.—*a* to Milton, 122 miles; stage, 24 miles.

Anita, Butte County.—*a* 195 miles.

Antelope, Sacramento County.—*a* 104 miles.

Antioch, Contra Costa County.—*a* 54 miles.

Applegate, Placer County.—*a* 136 miles.

Aptos, Santa Cruz County.—*b* 112 miles, or P. C.

Arbuckle, Colusa County.—*a* 114 miles.

Arcade, Sacramento County.—*a* 98 miles.

Arcata, Humboldt County.—P. C. to Eureka, 216 miles; stage, 12 miles.

Arena, Merced County.—*a* 140 miles.

Arroyo Grande, San Luis Obispo County.—*b* to Soledad, 143 miles; stage to San Luis Obispo, 114 miles, P. C. Ry., 15 miles; or P. C. to Port Harford, 201 miles, and P. C. Ry., 25 miles.

Ash Hill, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 131 miles.

Asti, Sonoma County.—S. F. & N. P., 80 miles.

Athlone, Merced County.—*a* 162 miles.

Atwater, Merced County.—*a* 144 miles.

Auburn, Placer County.—*a* 126 miles.

Avon, Contra Costa County.—*a* 39 miles.

Bakersfield, Kern County.—*a* to Sumner, 314 miles; stage, 1 mile.

Ballards, Santa Barbara County.—P. C. to Santa Barbara, 288 miles; stage, 43 miles; or P. C. to Port Harford, 201 miles; P. C. Ry. to Los Alamos, 64 miles; stage, 12 miles.

Baden, San Mateo County.—*b* 12 miles.

Bagdad, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 149 miles.

Bale, Napa County.—*a* 68 miles.

Balena, San Diego County.—*a* to Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 43 miles; or P. C. to San Diego, 482 miles; stage, 43 miles.

Ballona, Los Angeles County.—*a* 493 miles.

Bangor, Butte County.—*a* to Marysville, 142 miles; stage, 20 miles.

Banner, San Diego County.—*a* to Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 50 miles; P. C. to San Diego, 482 miles; stage, 50 miles.

Banning, San Bernardino County.—*a* 569 miles.

Banta, San Joaquin County.—*a* 75 miles.

Bartlett Springs, Lake County.—*a* to Calistoga, 73 miles; stage via Lakeport, 70 miles; or *a* to Williams, 125 miles; stage, 45 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage, 66 miles.

Barretts, Contra Costa County.—*a* 16 miles.

Barro, Napa County.—*a* 66 miles.

Batavia, Solano County.—*a* 65 miles.

Bay Point, Contra Costa County.—*a* 42 miles.

Bealville, Kern County.—*a* 342 miles.

Belmont, San Mateo County.—*b* 25 miles.
Bello, Napa County.—*a* 62 miles.
Bells Springs, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 102 miles.
Benicia, Solano County.—*a* 33 miles.
Benton, Mono County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C. 193 miles.
Berenda, Fresno County.—*a* 178 miles.
Berkeley, Alameda County.—*a* 12 miles.
Berlin, Colusa County.—*a* 119 miles.
Berry Creek, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 16 miles.
Bethany, San Joaquin County.—*a* 77 miles.
Bidwells Bar, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 9 miles.
Bieber, Lassen County.—*a* to Delta, 272 miles; stage, 70 miles.
Big Meadows, Plumas County.—*a* to Chico, 186 miles; stage, 65 miles.
Big Oak Flat, Tuolumne County.—*a* to Milton, 122 miles; stage, 44 miles.
Big Trees, Calaveras County.—*a* to Milton, 122 miles; stage, 47 miles.
Big Trees, Santa Cruz County.—S. P. C., 74 miles.
Big Trees, Mariposa County.—*a* to Raymond, 200 miles; stage, 40 miles.
Biggs Station, Butte County.—*a* 163 miles.
Big Valley, Lassen County.—*a* to Chico, 186 miles; stage, 80 miles.
Binghampton, Solano County.—*a* to Dixon, 68 miles; stage, 7 miles.
Birchville, Nevada County.—*a* to Marysville, 142 miles; stage, 36 miles.
Bishop Creek, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C., 224 miles.
Blacks, Yolo County.—*a* 97 miles.
Black Diamond, Contra Costa County.—*a* to Cornwall, 50 miles; Black Diamond R. R., 1 mile.
Black Point, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 36 miles.
Blithedale, Marin County.—N. P. C., 10 miles.
Blocksburg, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 138 miles.
Bloomfield, Sonoma County.—N. P. C. to Valley Ford, 61 miles; stage, 4 miles.
Blue Cañon, Placer County.—*a* 168 miles.
Blue Tent, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 6 miles.
Boca, Nevada County.—*a* 218 miles.
Bodega Roads, Sonoma County.—N. P. C. 64 miles.
Bodie, Mono County.—*a* to Reno, 245 miles; V. & T. to Mound House, 41 miles; C. and C. to Hawthorne, 100 miles; stage, 40 miles.
Bolinas, Marin County.—N. P. C. to San Rafael, 18 miles; stage, 18 miles.
Bolsa, San Benito County.—*a* 89 miles.
Boonville, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 30 miles.
Borden, Fresno County.—*a* 188 miles.
Boulder Creek, Santa Cruz County.—S. P. C. 81 miles.
Bowen's Landing, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 47 miles.
Brentwood, Contra Costa County.—*a* 63 miles.

Bridgeport, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 72 miles.

Bridgeport, Mono County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C. to Hawthorne, 100 miles; stage, 62 miles.

Brighton, Sacramento County.—*a* 134 miles.

Bristol, San Bernardino County.—*a* to Mojave, 382 miles; A. & P. 163 miles.

Bronco, Nevada County.—*a* 223 miles.

Brown's Valley, Yuba County.—*a* to Marysville, 142 miles; stage, 12 miles.

Brownsville, Yuba County.—*a* to Marysville, 142 miles; stage, 33 miles.

Brooklyn, Alameda County.—*a* 9 miles.

Brookside, San Bernardino County.—*a* 547 miles.

Brush Creek, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 25 miles.

Buckeye, Tehama County.—*a* 214 miles.

Buck's Ranch, Plumas County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 44 miles.

Buena Vista, Nevada County.—*a* to Colfax, 144 miles; N. C. 10 miles.

Burson, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. 24 miles.

Burgettsville, Shasta County.—*a* to Redding, 234 miles; stage, 80 miles.

Burdells, Sonoma County.—S. F. & N. P. 29 miles.

Burnetts, Stanislaus County.—*a* 124 miles.

Burney Valley, Shasta County.—*a* to Redding, 234 miles; stage, 64 miles.

Byron, Contra Costa County.—*a* 68 miles.

Byron Hot Springs, Contra Costa County.—*a* to Byron, 68 miles; stage, 2 miles.

Cabazon, San Bernardino County.—*a* 575 miles.

Cactus, San Diego County.—*a* 708 miles.

Cadiz, San Bernardino County.—*a* to Mojave, 382 miles; A. & P. 171 miles.

Cahto, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 74 miles.

Caliente, Kern County.—*a* 336 miles.

Calistoga, Napa County.—*a* 73 miles.

Callahans, Siskiyou County.—*a* to Delta, 272 miles; stage, 45 miles.

Calpella, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 34 miles.

Cambria, San Luis Obispo County.—P. C. to San Simeon, 160 miles; stage, 8 miles.

Cameron, Kern County.—*a* 371 miles.

Camp Bidwell, Modoc County.—*a* to Reno, 244 miles; N. & C. to Moran, 39 miles; stage, 245 miles.

Campbells, Santa Clara County.—S. P. C. 51 miles.

Camp Capitola, Santa Cruz County.—*b* to Soquel (Camp Capitola), 116 miles, or S. P. C. to Santa Cruz, 80 miles; stage, 5 miles.

Camp Taylor, Marin County.—N. P. C., 30 miles.

Campo, San Diego County.—*a* to Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 60 miles; or P. C. to San Diego, 480 miles; stage, 60 miles.

Campo Seco, Calaveras County.—*a* to Lodi, 104 miles; S. J. and S. N. to Valley Spring, 28 miles; stage, 2 miles.

Camptonville, Nevada County.—*a* to Marysville, 142 miles; stage, 43 miles; or *a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 22 miles.

Cana, Butte County.—*a* 198 miles.

Carbondale, Amador County.—*a* 133 miles.
Cannon, Solano County.—*a* 56 miles.
Carnadero, San Benito County.—*b* 82 miles.
Carpenteria, Santa Barbara County.—*a* to Newhall, 452 miles, and stage; or P. C. to Santa Barbara, 288 miles; stage, 8 miles.
Cascade, Nevada County.—*a* 189 miles.
Cape Horn, Placer County.—*a* 148 miles.
Caspar, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 101 miles, or P. C.
Castle Rock, Shasta County.—*a* to Delta, 272 miles; stage, 27 miles.
Castroville, Monterey County.—*b* 110 miles.
Castle, San Joaquin County.—*a* 98 miles.
Cave City, Calaveras County.—*a* to Milton, 122 miles; stage, 32 miles; or *a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 22 miles.
Ceres, Stanislaus County.—*a* 119 miles.
Cerro Gordo, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C. to Hawley, 293 miles; stage, 6 miles.
Cerritos, Los Angeles County.—*a* 498 miles.
Charleston, San Joaquin County.—*a* 98 miles.
Cherokee Flat, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 12 miles.
Cherokee (Patterson), Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 12 miles.
Chico, Butte County.—*a* 186 miles.
Chili Bar, El Dorado County.—*a* 90 miles to Sacramento; S. & P. to Shingle Springs, 48 miles; stage, 14 miles.
China Ranch, Placer County.—*a* 166 miles.
Chinese Camp, Tuolumne County.—*a* to Milton, 122 miles; stage, 26 miles.
Chinns, Placer County.—*a* 173 miles.
Christine, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 30 miles.
Chualar, Monterey County.—*b* 128 miles; or P. C. S.
Cicero, Sacramento County.—*a* 121 miles.
Cienega, Los Angeles County.—*a* 490 miles.
Cisco, Placer County.—*a* 182 miles.
Clairville, Sonoma County.—S. F. & N. P., 74 miles.
Clarks Summit, Marin County.—N. P. C., 59 miles.
Clay, Sacramento County.—*a* 124 miles.
Clear Creek, Shasta County.—*a* 229 miles.
Clements, San Joaquin County.—*a* to Lodi, 104 miles; S. J. & S. N., 12 miles.
Clinton, Nevada County.—*a* 220 miles.
Clipper Mills, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 30 miles.
Clipper Gap, Placer County.—*a* 133 miles.
Clyde, San Joaquin County.—*a* 119 miles.
Cloverdale, Sonoma County.—S. F. & N. P., 84 miles.
Coles, Siskiyou County.—*a* to Delta, 272 miles; stage, 100 miles.
Colfax, Placer County.—*a* 144 miles.
Collinsville, Solano County.—Stmr., 40 miles.
Coloma, El Dorado County.—*a* to Auburn, 126 miles; stage, 20 miles.
Colma, San Mateo County.—*b* 9 miles.
Colton, San Bernardino County.—*a* 540 miles.

Columbia, Tuolumne County.—*a* to Milton, 122 miles; stage, 49 miles.

Columbia Hill, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 12 miles; or *a* to Marysville, 142 miles; stage, 47 miles.

Colusa, Colusa County.—*a* to Colusa Junction, 129 miles; Colusa R. R., 10 miles.

Comanche, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Wallace, 18 miles; stage, 3 miles.

Cometa, San Joaquin County.—*a* 117 miles.

Compton, Los Angeles County.—*a* 494 miles.

Copper City, Shasta County.—*a* to Redding, 234 miles; stage, 25 miles.

Copperopolis, Calaveras County.—*a* to Milton, 122 miles; stage, 13 miles.

Cordelia, Solano County.—*a* 46 miles.

Cordero, San Diego County.—*a* to Colton, 540 miles; C. S., 101 miles.

Corning, Tehama County.—*a* 179 miles.

Cornwall, Contra Costa County.—*a* 50 miles.

Corralitos, Santa Cruz County.—*b* to Watsonville, 101 miles; stage, 7 miles.

Corte Madera, Marin County.—N. P. C., 12 miles.

Costa, Los Angeles County.—*a* 505 miles.

Cotate Ranch, Sonoma County.—S. F. & N. P., 46 miles.

Cothrins, El Dorado County.—*a* to Sacramento, 90 miles; S. & P., 34 miles.

Cottonwood, Shasta County.—*a* 216 miles.

Cuba, Nevada County.—*a* 222 miles.

Coulterville, Mariposa County.—*a* to Merced, 152 miles; stage, 46 miles.

Courtland, Sacramento County.—Stmr., 95 miles.

Covello, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Ukiah, 30 miles; stage, 65 miles.

Coyote, Santa Clara County.—*b* 63 miles.

Crescent City, Del Norte County.—Steamer Crescent City, every ten days; 274 miles.

Cayucos, San Luis Obispo County.—P. C. 180 miles.

Cedarville, Modoc County.—*a* to Reno, 244 miles; N. & C. to Moran, 30 miles; stage, 186 miles.

Centerville, Alameda County.—S. P. C. to Newark, 29 miles; horse-car, 3 miles; or *a* to Niles, 30 miles; stage, 3 miles.

Crescent Mills, Plumas County.—*a* to Chico, 186 miles; stage, 64 miles; or *b* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 81 miles.

Cross Creek, Tulare County.—*a* 235 miles.

Crystal Springs, San Mateo County.—*b* to San Mateo, 21 miles; stage, 4 miles.

Cucamonga, San Bernardino County.— *a* 524 miles.

Cuffey's Cove, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 80 miles. or P. C., 112 miles.

Cummings, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 90 miles.

Daggett, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 80 miles.

Danby, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 183 miles.

Darwin, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C. to Hawley, 293 miles; stage, 22 miles.

Davenport's Landing, Santa Cruz County.—*b* to San Mateo, 21 miles; stage, 57 miles; or S. P. C. to Santa Cruz, 81 miles; stage, 14 miles.

Davis, Yolo County.—*a* 77 miles.

Dayton, Butte County.—*a* to Chico, 186 miles; stage, 6 miles.

Deadwood, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 21 miles.

Decoto, Alameda County.—*a* 27 miles.

De Luz, San Diego County.—*a* to Colton, 540 miles; C. S., 66 miles.

Delano, Kern County.—*a* 282 miles.

Delavan, Colusa County.—*a*, 139 miles.

Delhi, Merced County.—*a*, 133 miles.

Delta, Shasta County.—*a*, 272 miles.

Denverton, Solano County.—Steamer to Rio Vista, 89 miles; stage, 14 miles; or *a* to Suisun, 49 miles; stage, 9 miles.

Diamond Springs, El Dorado County.—*a* 90 miles to Sacramento; S. & P. to Shingle Springs, 48 miles; stage, 7 miles.

Dixon, Solano County.—*a* 68 miles.

Dogtown, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 32 miles.

Dominguez, Los Angeles County.—*a* 496 miles.

Donahue, Sonoma County.—S. F. & N. P., 36 miles.

Donner Lake, Nevada County.—*a* to Summit, 195 miles; stage, 2 miles.

Dougherty's, Santa Cruz County.—S. P. C., 70 miles.

Downey, Los Angeles County.—*a* 495 miles.

Downieville, Sierra County.—*a* to Marysville, 142 miles; stage, 67 miles; or *a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 42 miles.

Drytown, Amador County.—*a* to Ione, 140 miles; stage, 16 miles.

Dugan's, El Dorado County.—*a* to Sacramento, 90 miles; S. & P., 42 miles.

Dry Camp, San Diego County.—*a* 602 miles.

Duncan Mills, Sonoma County.—N. P. C., 79 miles.

Dunnigan, Yolo County.—*a* 104 miles.

Durham, Butte County.—*a* 180 miles.

Dutch Flat, Placer County.—*a* 157 miles.

East Oakland, Alameda County.—*a* 9 miles.

Eden Vale, Santa Clara County.—*b* 57 miles.

Eden Valley, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Ukiah, 30 miles; stage, 45 miles.

Edson, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 192 miles.

El Dorado, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage; 20 miles.

El Casco, San Bernardino County.—*a* 554 miles.

El Rio, San Diego County.—*a* 725 miles.

Elk Grove, Sacramento County.—*a* 124 miles.

Ellis, San Joaquin County.—*a* 70 miles.

Elmira, Solano County.—*a* 60 miles.

Elsinore, San Diego County.—*a* to Colton, 540 miles; C. S. 34 miles.

Ely's, Sonoma County.—S. F. & N. P., 30 miles.

Emigrant Gap, Placer County.—*a* 173 miles.

Emmaton, Sacramento County.—Steamer, 56 miles.

Encinitas, San Diego County.—*a* to Colton, 540 miles; C. S. 92 miles.

Eperson, Colusa County.—*a* to Williams, 125 miles; stage, 26 miles.

Eureka, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Hydesville, 182 miles; E. R. & E. R. R. to Eureka, 24 miles; or P. C., 216 miles.

Ewing, Placer County.—*a* 123 miles.

Fairfax, Marin County.—N. P. C., 17 miles.
Fair Oaks, San Mateo County.—*b* 31 miles.
Fall City, Shasta County.—*a* to Redding, 234 miles; stage, 80 miles.
Fallbrook, San Diego County.—*a* to Colton, 540 miles; C. S., 60 miles.
Farmington, San Joaquin County.—*a* 111 miles.
Felton, Santa Cruz County.—S. P. C., 73 miles; or *b* to Santa Cruz, 121 miles; S. P. C., 7 miles.
Fenner, San Bernardino County.—*a* to Mojave, 382 miles; A. & P. 199 miles.
Ferndale, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Eureka, 210 miles; stage, 17 miles; or P. C. S.
Ferndale, Alameda County.—*a* 12 miles.
Fiddletown, Amador County.—*a* to Ione, 140 miles; stage, 22 miles.
Field's Landing, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Hydesville, 182 miles; E. R. & E. R. R. to Field's Landing, — miles.
Finnell, Tehama County.—*a* 185 miles.
Firebaugh's, Fresno County.—*a* to Madera, 185 miles; stage, 20 miles.
Fish Rock, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 50 miles.
Fisherman's, Marin County.—N. P. C., 45 miles.
Fisherman's Bay, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 33 miles.
Fisk's Mills, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 30 miles.
Florin, Sacramento County.—*a* 130 miles.
Florence, Los Angeles County.—*a* 488 miles.
Folsom, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 22 miles.
Flowing Well, San Diego County.—*a* 671 miles.
Forbestown, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 22 miles.
Forest City, Sierra County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 40 miles; or *a* to Marysville, 142 miles; stage, 60 miles.
Forest Hill, Placer County.—*a* to Auburn, 126 miles; stage, 22 miles.
Forest Home, Amador County.—*a* to Ione, 140 miles; stage, 4 miles.
Forestville, Sonoma County.—S. F. & N. P., 64 miles.
Fort Jones, Siskiyou County.—*a* to Delta, 272 miles; stage, 107 miles.
Fort Ross, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 17 miles.
Fort Yuma, San Diego County.—*a* 729 miles.
Fowler, Fresno County.—*a* 216 miles.
Fraziers, San Diego County.—*a* to Colton, 540 miles; C. S., 83 miles.
Freeport, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 7 miles.
Freestone, Sonoma County.—N. P. C., 65 miles.
French Camp, San Joaquin County.—*a* 87 miles.
French Corral, Nevada County.—*a* to Marysville, 142 miles; stage, 33 miles.
Fresno, Fresno County.—*a* 207 miles.
Frinks, San Diego County.—*a* 653 miles.
Fruitvale, Alameda County.—*a* 10 miles.
Fulton, Sonoma County.—S. F. & N. P., 56 miles.

Gabilan, Monterey County.—*b* to Salinas, 118 miles; stage, 10 miles.
Galt, Sacramento County.—*a* 113 miles.
Garcia, Marin County.—N. P. C., 34 miles.
Garden Valley, El Dorado County.—*a* to Auburn, 126 miles; stage, 25 miles.
Garrotte, Tuolumne County.—*a* to Milton, 122 miles; stage, 37 miles.
Gaviota, Santa Barbara County.—P. C., 260 miles.
Germantown, Colusa County.—*a* 158 miles.
Georgetown, El Dorado County.—*a* to Auburn, 126 miles; stage, 22 miles.
Geyser Springs, Sonoma County.—*a* to Calistoga, 73 miles; stage, 27 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage, 15 miles.
Gibsonville, Sierra County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 28 miles.
Gilroy, Santa Clara County.—*b* 80 miles.
Gilroy Hot Springs, Santa Clara County.—*b* to Gilroy, 80 miles; stage, 10 miles.
Girard, Kern County.—*a* 355 miles.
Glenbrook, Lake County.—*a* to Calistoga, 73 miles; stage, 29 miles.
Glencoe, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Springs, 28 miles; stage, 20 miles.
Glendale, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 12 miles.
Glen Ellen, Sonoma County.—S. V., 44 miles.
Glenwood, Santa Cruz County.—S. P. C., 66 miles.
Gloster, Kern County.—*a* 388 miles.
Goffs, San Bernardino County.—*a* to Mojave, 382 miles; A. & P. 209 miles.
Gold Run, Placer County.—*a* 154 miles.
Gonzales, Monterey County.—*b* 134 miles.
Goodwins, Sonoma County.—S. F. & N. P., 41 miles.
Goodyears, Solano County.—*a* 39 miles.
Goshen, Tulare County.—*a* 241 miles.
Graciosa, Santa Barbara County.—P. C. to Port Harford, 201 miles; P. C. R., 49 miles.
Grand Island, Colusa County.—*a* to Knight's Landing, 95 miles; stmr., 36 miles.
Granite Hill, El Dorado County.—*a* to Auburn, 126 miles; stage, — miles.
Graniteville (Eureka South), Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 27 miles.
Grant's Station, Sonoma County.—S. F. & N. P., 64 miles.
Green Brae, Marin County.—S. F. & N. P., 13 miles.
Grass Valley, Nevada County.—*a* to Colfax, 144 miles; N. C., 17 miles.
Green Valley, Sonoma County.—S. F. & N. P., 66 miles.
Greenville, Plumas County.—*a* to Chico, 186 miles; stage, 60 miles; or *a* to Reno, 244 miles; N. & C. to Moran, 39 miles; stage, 24 miles.
Greenwood, Colusa County.—*a* 163 miles.
Greenwood, El Dorado County.—*a* to Auburn, 126 miles; stage, 4 miles.
Gridley, Butte County.—*a* 160 miles.
Griffins, Marin County.—N. P. C., 57 miles.
Guadalupe, Santa Barbara County.—P. C. to Port Harford, 201 miles; P. C. Ry. and stage, 24 miles.

Gualala, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 45 miles.
Guerneville, Sonoma County.—S. F. & N. P., 72 miles.

Halls, Alameda County.—S. P. C., 25 miles.
Hamlet, Marin County.—N. P. C., 51 miles.
Hanford, Tulare County.—*a* 254 miles.
Hangtown Crossing, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 12 miles.
Harper, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 51 miles.
Harrington, Colusa County.—*a* 109 miles.
Harbin Springs, Lake County.—*a* to Calistoga, 73 miles; stage, 21 miles.
Havilah, Kern County.—*a* to Caliente, 336 miles; stage, 28 miles.
Hawley, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C., 293 miles.
Haslett, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 105 miles.
Haywards, Alameda County.—*a* 21 miles.
Healdsburg, Sonoma County.—S. F. & N. P., 66 miles.
Heinlen, Tulare County.—*a* 263 miles.
Henly, Siskiyou County.—*a* to Delta, 272 miles; stage, 94 miles.
Highland, Santa Cruz County.—S. P. C., 64 miles.
Highland Springs, Lake County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 28 miles.
Highland, Alameda County.—*a* 12 miles.
Hilarita, Marin County.—S. F. & N. P., 7 miles.
Hinckley, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 61 miles.
Holden, San Joaquin County.—*a* 103 miles.
Hollister, San Benito County.—*b* 94 miles.
Honcut, Butte County.—*a* to Marysville, 142 miles; C. N., 12 miles.
Homer, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 217 miles.
Homestead, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 3 miles.
Hooker, Tehama County.—*a* 209 miles.
Hookton, Humboldt County.—P. C., 222 miles.
Hopland, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 16 miles.
Hornitos, Mariposa County.—*a* to Merced, 152 miles; stage, 22 miles.
Hotel de Redwood, Santa Cruz County.—S. P. C. to Wrights, 62 miles; stage, 4 miles.
Hotel del Monte, Monterey County.—(See Monterey.)
Houghs Mineral Springs, Lake County.—*a* to Williams, 125 miles; stage, 38 miles.
Howards, Sonoma County.—N. P. C., 69 miles.
Howland Flat, Sierra County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 55 miles.
Hueneme, Ventura County.—P. C., 321 miles.
Humboldt Bay, Humboldt County.—P. C., 216 miles.
Huron, Tulare County.—*a* 281 miles.
Hydesville, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 182 miles; or P. C. to Eureka, 216 miles; stage, 25 miles.

Ibex, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 226 miles.

Igo, Shasta County.—*a* to Anderson, 223 miles; stage, 14 miles.

Independence, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C., 276 miles.

Indio, San Diego County.—*a* 612 miles.

Ingrams, Sonoma County.—N. P. C., 87 miles.

Ione, Amador County.—*a* to Galt, 140 miles.

Iowa Hill, Placer County.—*a* to Colfax, 144 miles; stage, 8 miles.

Jacinto, Colusa County.—*a* to Chico, 186 miles; stage, 15 miles.

Jackson, Amador County.—*a* to Ione, 140 miles; stage, 12 miles.

Jacksonville, Tuolumne County.—*a* to Milton, 122 miles; stage, 29 miles.

Java, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 233 miles.

Jamestown, Tuolumne County.—*a* to Milton, 122 miles; stage, 31 miles.

Janesville, Lassen County.—*a* to Reno, 244 miles; N. & C. to Moran, 39 miles; stage, 41 miles.

Jenny Lind, Calaveras County.—*a* to Milton, 122 miles; stage, 4 miles.

Jewells, Marin County.—N. P. C., 3 1miles.

Jolon, Monterey County.—*b* to Soledad, 143 miles; stage, 42 miles.

Julian, San Diego County.—*a* to Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 65 miles; or P. C. to San Diego, 482 miles; stage, 65 miles.

Junction, Marin County.—S. F. & N. P., 35 miles.

Junction (Roseville), Placer County.—*a* 108 miles.

Keene, Kern County.—*a* 350 miles.

Kent, Los Angeles County.—*a* 444 miles.

Kelsey, El Dorado County.—*a* to Auburn, 126 miles; stage, 28 miles.

Kelseyville, Lake County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 33 miles; or *a* to Calistoga, 73 miles; stage, 40 miles.

Kernville, Kern County.—*a* to Caliente, 336 miles; stage, 40 miles.

Keyes, Stanislaus County.—*a* 122 miles.

Kingsburg, Tulare County.—*a* 227 miles.

Kibbesilla, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 90 miles; or N. P. C. to Duncan Mills, 79 miles; stage, 120 miles.

Kirkwood, Tehama County.—*a* 174 miles.

Klamath Ferry, Siskiyou County.—*a* to Delta, 272 miles; stage, 90 miles.

Knights Ferry, Stanislaus County.—*a* to Oakdale, 126 miles; stage, 12 miles.

Knights Landing, Yolo County.—*a* 95 miles.

Knoxville, Napa County.—*a* to Calistoga, 73 miles; stage, 28 miles.

Korbells, Sonoma County.—S. F. & N. P., 69 miles.

Kramer, Kern County.—*a* to Mojave, 382 miles; A. & P., 38 miles.

Kress Summit, Nevada County.—*a* to Colfax, 144 miles; N. C., 13 miles.

La Graciosa, Santa Barbara County.—P. C.

La Grange, Stanislaus County.—*a* to Modesto, 114 miles; stage, 32 miles.

La Honda, San Mateo County.—*b* to Redwood, 29 miles; stage, 18 miles.

La Porte, Plumas County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 45 miles.

Laguna, Sonoma County.—S. F. & N. P., 62 miles.

Lagunitas, Marin County.—N. P. C., 27 miles.

Lake City (Surprise Valley), Modoc County.—*a* to Reno, 244 miles; stage, 220 miles; or *a* to Redding, 234 miles; stage, 220 miles.

Lake City, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 12 miles.

Lake Tahoe—(see Tahoe City).

Lakeport, Lake County.—*a* to Calistoga, 73 miles; stage, 46 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage, 40 miles.

Lakeville, Sonoma County.—S. F. & N. P., 36 miles.

Lakeview, Modoc County.—*a* to Marysville, 142 miles; stage, 225 miles.

Lancaster, Los Angeles County.—*a* 406 miles.

Lancha Plana, Amador County.—*a* to Lodi, 104 miles; S. J. & S. N. to Wallace, 18 miles; stage, 7 miles.

Lander, Placer County.—*a* 141 miles.

Langville, Yolo County.—*a* to Woodland, 86 miles; stage, 16 miles.

Lang, Los Angeles County.—*a* 439 miles.

Lathrop, San Joaquin County.—*a* 83 miles.

Latrobe, El Dorado County.—*a* to Sacramento, 90 miles; S. & P., 37 miles.

Lawrence, Santa Clara County.—*b* 44 miles.

Laytonville, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 78 miles.

Leesville, Colusa County.—*a* to Williams, 125 miles; stage, 21 miles.

Lemoore, Tulare County.—*a* 262 miles.

Lerdo, Kern County.—*a* 302 miles.

Lexington, Santa Clara County.—S. P. C. to Alma, 58 miles; stage, 7 miles; or *b* to Santa Clara, 47 miles; stage, 15 miles.

Liebigs, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 22 miles.

Lincoln, Placer County.—*a* 119 miles.

Linden, San Joaquin County.—*a* to Stockton, 92 miles; stage, 14 miles.

Little River, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 93 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage, 73 miles, or P. C.

Little York, Nevada County.—*a* to Colfax, 144 miles; N. C., 22 miles; stage, 13 miles.

Litton Springs, Sonoma County.—S. F. & N. P., 70 miles.

Live Oak, Sutter County.—*a* 153 miles.

Livermore, Alameda County.—*a* 48 miles.

Livingston, Merced County.—*a* 137 miles.

Lockeford, San Joaquin County.—*a* to Lodi, 104 miles; S. J. & S. N., 8 miles.

Lodi, San Joaquin County.—*a* 104 miles.

Logandale, Colusa County.—*a* 145 miles.

Lomo, Sutter County.—*a* 149 miles.

Lompoc, Santa Barbara County.—P. C. to Gaviota, 260 miles; stage, 14 miles.

Lompoc, San Luis Obispo County.—P. C. to Port Harford, 201 miles; P. C. Ry. to Los Alamos, 64 miles; stage, 12 miles.

Lone Pine, Inyo County.—*a* to Reno, 244 miles; V. T. to Mound House, 41 miles; C. & C., 281 miles.

Lorenzo, Alameda County.—*a* 18 miles.

Lorenzo, Santa Cruz County.—S. P. C., 80 miles.

Los Alamos, Santa Barbara County.—P. C. to Port Harford, 201 miles; P. C. Ry., 64 miles.

Los Angeles, Los Angeles County.—*a* 482 miles; or P. C. to San Pedro, 389 miles; *a* 25 miles.
Los Banos, Merced County.—*b* to Gilroy, 80 miles; stage, 52 miles.
Los Berros, San Luis Obispo County.—P. C. to Port Harford, 201 miles; P. C. Ry., 30 miles.
Los Flores, San Diego County.—*a* Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 28 miles; or P. C. to San Diego, 482 miles; stage, 28 miles.
Los Gatos, Santa Clara County.—S. P. C., 55 miles.
Los Medanos, Contra Costa County.—*a* 51 miles.
Louisville, El Dorado County.—*a* to Auburn, 126 miles; stage, 29 miles.
Lovejoys, El Dorado County.—*a* to Auburn, 126 miles; stage, 7 miles.
Lovelady, Santa Clara County.—S. P. C., 51 miles.
Lower Lake, Lake County.—*a* to Calistoga, 73 miles; stage, 35 miles.
Lowes, Monterey County.—*b* to Soledad, 143 miles; stage, 28 miles.
Ludlow, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 125 miles.
Lyfords, Marin County.—N. P. C., 10 miles.
Lyman, Colusa County.—*a* 154 miles.

Macy, Colusa County.—*a* 119 miles.
Madison, Yolo County.—*a* to Elmira, 60 miles; V. V. & C. L., 29 miles.
Madera, Fresno County.—*a* 185 miles.
Madrone, Santa Clara County.—*b* 69 miles.
Magnetic Springs.—S. P. C., to Glenwood, 66 miles; stage, 4 miles.
Malaga, Fresno County.—*a* 211 miles.
Malton, Colusa County.—*a* 170 miles.
Mammoth Tank, San Diego County.—*a* 683 miles.
Manchester, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 65 miles, or P. C.
Mariposa, Mariposa County.—*a* to Merced, 152 miles; stage, 41 miles.
Markleeville, Alpine County.—*a* to Reno, 244 miles; V. & T. to Carson, 31 miles; stage, 39 miles.
Mark West, Sonoma County.—S. F. & N. P., 57 miles.
Markhams, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 3 miles.
Marshalls, Marin County.—N. P. C., 47 miles.
Martinez, Contra Costa County.—*a* 36 miles.
Marysville, Yuba County.—*a* 142 miles.
Maxwell, Colusa County.—*a* 134 miles.
Mayfield, Santa Clara County.—*b* 35 miles.
Mayhews, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 10 miles.
McAvoy, Contra Costa County.—*a* 45 miles.
McConnells, Sacramento County.—*a* 120 miles.
Meacham's, Sonoma County.—S. F. & N. P., 58 miles.
Meadow Valley, Plumas County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 53 miles.
Melrose, Alameda County.—*a* 11 miles.
Mendocino, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 8 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage, 75 miles; or P. C., 122 miles.
Menlo Park, San Mateo County.—*b* 32 miles.
Merced, Merced County.—*a* 152 miles.
Merced Falls, Merced County.—*a* to Merced, 152 miles; stage, 22 miles.
Meridian, Sutter County.—*a* to Marysville, 142 miles; stage, 17 miles.

Michigan Bar, Sacramento County.—*a* to Sacramento, 90 miles; S. & P. to Latrobe, 37 miles; stage, 6 miles.

Michigan Bluffs, Placer County.—*a* to Auburn, 126 miles; stage, 30 miles.

Middletown, Lake County.—*a* to Calistoga, 73 miles; stage, 18 miles.

Midway, Alameda County.—*a* 64 miles.

Milford, Lassen County.—*a* to Reno, 244 miles; N. & C. to Moran, 39 miles; stage, 28 miles.

Millbrae, San Mateo County.—*b* 17 miles.

Millerton, Fresno County.—*a* to Borden, 188 miles; stage, 20 miles.

Millerton, Marin County.—N. P. C., 42 miles.

Millers, Marin County.—S. F. & N. P., 20 miles.

Millville, Shasta County.—*a* to Redding, 234 miles; stage, 15 miles.

Milpitas, Santa Clara County.—*a* 42 miles.

Milton, Calaveras County.—*a* 122 miles.

Minturn, Fresno County.—*a* 168 miles.

Mitchel, Alameda County.—*a* 13 miles.

Modesto, Stanislaus County.—*a* 114 miles.

Mojave, Kern County.—*a* 382 miles.

Mokelumne Hill, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 12 miles.

Monitor, Alpine County.—*a* to Reno, 244 miles; V. & T. to Carson, 31 miles: stage, 36 miles.

Monte, Los Angeles County.—*a* 495 miles.

Monticello, Napa County.—*a* to Napa, 46 miles; stage, 27 miles.

Monterey, Monterey County.—*b* 125 miles; or P. C., 85 miles.

Montezuma, Tuolumne County.—To Milton, 122 miles; stage, 28 miles.

Moore's Flat, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 20 miles.

Morrano, San Joaquin County.—*a* 100 miles.

Morro, San Luis Obispo County.—P. C., 166 miles.

Moscow Mills, Sonoma County.—N. P. C., 78 miles.

Mosquito Gulch, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 17 miles.

Mound City, San Bernardino County.—*a* 543 miles.

Mount Eden, Alameda County.—S. P. C., 20 miles; or *a* to Haywards, 21 miles; stage, 8 miles.

Mountain House, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 24 miles.

Mountain Ranch, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 20 miles.

Mountain View, Santa Clara County.—*b* 39 miles.

Mowrys, Alameda County.—S. P. C., 32 miles.

Mud Springs (El Dorado), El Dorado County.—*a* to Sacramento, 90 miles; S. & P. to Shingle Springs, 48 miles; stage, 5 miles.

Murrieta, San Diego County.—*a* to Colton, 540 miles; C. S., 43 miles.

Murphys, Calaveras County.—*a* to Milton, 122 miles; stage, 33 miles.

Mystic, Nevada County.—*a* 227 miles.

Nacimento, Monterey County.—*b* to Soledad, 143 miles; stage to San Miguel, 73 miles.

Nadeau, Kern County.—*a* 376 miles.

Napa, Napa County.—*a* 46 miles.

Napa Junction, Napa County.—*a* 38 miles.

Nashville, El Dorado County.—*a* to Sacramento, 90 miles; S. & P. to Shingle Springs, 48 miles; stage, 4 miles.

National City, San Diego County.—*a* to Colton, 540 miles; C. S., 127 miles, or P. C. S.

Natividad, Monterey County.—*b* to Salinas, 118 miles; stage, 8 miles.

Navarro Ridge, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 63 miles; or N. P. C. to Duncan Mills, 79 miles; stage, 85 miles; or P. C. to Whitesboro.

Nelson, Butte County.—*a* 173 miles.

Nevada, Nevada County.—*a* to Colfax, 144 miles; N. C., 22 miles.

New Hope, San Joaquin County.—*a* to Lodi, 104 miles; stage, 14 miles.

New Idria, Fresno County.—*b* to Tres Pinos, 100 miles; stage, 63 miles.

New York Landing, Contra Costa County.—Stmr., 39 miles.

New Almaden, Santa Clara County.—*b* to San José, 50 miles; stage, 15 miles.

Newark, Alameda County.—S. P. C., 29 miles.

Newcastle, Placer County.—*a* 121 miles.

Newhall, Los Angeles County.—*a* 452 miles.

Newville, Colusa County.—*a* to Williams, 125 miles; stage, 65 miles.

Neylans Mills, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 57 miles.

N. E. Mills, Placer County.—*a* 139 miles.

Nicasio, Marin County.—N. P. C. 25 miles; stage, 3 miles.

Nicolaus, Sutter County.—*a* to Wheatland, 130 miles; stage, 4 miles.

Niles, Alameda County.—*a* 30 miles.

Nipomo, San Luis Obispo County.—*a* P. C. to Port Harford, 201 miles; P. C. Ry., 35 miles.

Nord, Butte County.—*a* 193 miles.

Nordhoff, Ventura County.—P. C. to San Buenaventura, 311 miles; stage, 12 miles; or *a* Newhall, 452 miles; stage, 60 miles.

Norman, Colusa County.—*a* 143 miles.

North Bloomfield, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 15 miles.

North San Juan, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 12 miles; or *a* to Marysville, 142 miles; stage, 45 miles.

Nortonville, Contra Costa County.—*a* to Cornwall, 50 miles; Black Diamond R. R., 6 miles.

Norwalk, Los Angeles County.—*a* 499 miles; or by P. C. to Los Angeles.

Novato, Marin County.—S. F. & N. P., 26 miles.

Noyo, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 83 miles; or N. P. C. to Duncan Mills, 79 miles; stage, 106 miles; or P. C.

Oak Grove, San Mateo County.—*b* 19 miles.

Oak Grove, Sonoma County.—S. F. & N. P., 48½ miles.

Oak Knoll, Napa County.—*a* 51 miles.

Oakdale, Stanislaus County.—*a* 126 miles.

Oakland, Alameda County.—*a* 6 miles; or S. P. C., 8 miles.

Oakville, Napa County.—*a* 58 miles.

Oat Creek, Tehama County.—*a* 192 miles.

Ocean Side, San Diego County.—*a* to Colton, 540 miles; C. S., 80 miles.

Ocean View, San Francisco County.—*b* 7 miles.

Ocean View, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 14 miles.

Ogilby, San Diego County.—*a* 715 miles.

Olema, Marin County.—N. P. C., 38 miles.
Omega, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 20 miles.
Ontario, San Bernardino County.—*a* 521 miles.
Ophir, Placer County.—*a* to Newcastle, 121 miles; stage, 2 miles.
Orange, Los Angeles County.—*a* 514 miles.
Oregon House, Yuba County.—*a* to Marysville, 142 miles; stage, 23 miles.
Orland, Colusa County.—*a* 166 miles.
Oro Fino, Siskiyou County.—*a* to Delta, 272 miles; stage, 65 miles.
Oroville, Butte County.—*a* to Marysville, 142 miles; C. N., 28 miles.
Otay, San Diego County.—*a* via San Diego or P. C.

Pacheco, Contra Costa County.—*a* to Martinez, 36 miles; stage, 5 miles.
Pacific Congress Springs, Santa Clara County.—*b* to Santa Clara, 47 miles; stage, 11 miles; or S. P. C. to Los Gatos, 55 miles; stage, 5 miles.
Pacheco, Marin County.—S. F. & N. P., 23 miles; or N. P. C., 18 miles.
Pages, Sonoma County.—S. F. & N. P., 43 miles.
Pajaro, Santa Clara County.—*b* 99 miles.
Pampa, Kern County.—*a* 329 miles.
Paraiso Springs, Monterey County.—*b* to Soledad, 143 miles; stage, 7 miles.
Paso Robles Hot Springs, San Luis Obispo County.—*b* to Soledad, 143 miles; stage, 78 miles; or P. C. to Port Harford, 201 miles; P. C. Ry. to San Luis Obispo, 11 miles; stage, 30 miles.
Patchin, Santa Clara County.—*b* to Santa Clara, 47 miles; stage: or S. P. C. to Alma, 45 miles; stage.
Pasadena, Los Angeles County.—*a* to Los Angeles, 482 miles; Los Angeles and San Gabriel Valley R. R., 10 miles.
Pearsons Springs, Lake County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 46 miles.
Penns Grove, Sonoma County.—S. F. & N. P., 40 miles.
Penyrn, Placer County.—*a* 118 miles.
Pentz, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 12 miles.
Perkins, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 7 miles.
Perrys, Santa Cruz County.—*b* 66 miles.
Pescadero, San Mateo County.—*b* to San Mateo, 21 miles; stage, 32 miles; or *b* to Redwood, 29 miles; stage, 35 miles.
Petaluma, Sonoma County.—S. F. & N. P., 36 miles.
Peters, San Joaquin County.—*a* 107 miles.
Petrolia, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Eureka, 210 miles; stage, 50 miles; or P. C. to Eureka.
Pino, Placer County.—*a* 115 miles.
Pigeon Point, San Mateo County.—*b* to San Mateo, 21 miles; stage, 39 miles.
Pike City, Sierra County.—*a* to Marysville, 142 miles; stage, 50 miles; or *a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 27 miles.
Pilot Hill, El Dorado County.—*a* to Auburn, 126 miles; stage, 8 miles.
Pilot Knob, San Diego County.—*a* 721 miles.
Pinacate, San Diego County.—*a* to Colton, 540 miles; C. S., 22 miles.
Pine Flat, Sonoma County.—*a* to Calistoga, 73 miles; stage, 18 miles.
Pinole, Contra Costa County.—*a* 24 miles.
Platts Mill, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 30 miles.
Placerville, El Dorado County.—*a* to Sacramento, 90 miles; S. & P. to Shingle Springs, 48 miles; stage, 10 miles.

Pleasanton, Alameda County.—*a* 42 miles.

Pleasant Valley, El Dorado County.—*a* to Sacramento, 90 miles; S. & P. to Shingle Springs, 48 miles; stage, 21 miles.

Pleito, Monterey County.—*b* to Soledad, 143 miles; stage, 54 miles.

Plymouth, Amador County.—*a* to Ione, 140 miles; stage, 18 miles.

Point Arena, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 60 miles; or P. C., 100 miles.

Point Reyes (Olema), Marin County.—N. P. C., 38 miles.

Point Tiburon, Marin County.—S. F. &. N. P., 6 miles.

Pomona, Los Angeles County.—*a* 515 miles.

Port Costa, Contra Costa County.—*a* 32 miles.

Port Harford, San Luis Obispo County.—P. C. S., 201 miles.

Poso, Kern County.—*a* 294 miles.

Potter Valley, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 48 miles.

Poway, San Diego County.—P. C. to San Diego, 482 miles; stage, 22 miles; or *a* to Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 22 miles.

Prairie, Yolo County.—*a* to Blacks, 97 miles; stage, 2 miles.

Prattville, Plumas County.—*a* to Chico, 186 miles; stage, 40 miles.

Princeton, Colusa County.—*a* to Norman, 143 miles; stage, 10 miles.

Proctors, Nevada County.—*a* 212 miles.

Prosser, Nevada County.—*a* 216 miles.

Puente, Los Angeles County.—*a* 501 miles.

Purissima, San Mateo County.—*b* to San Mateo, 21 miles; stage, 18 miles.

Quaker Hill, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 7 miles.

Quincy, Plumas County.—*a* to Reno, 244 miles; N. & C. to Moran, 39 miles; stage, 60 miles.

Railroad Flat, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 25 miles.

Ravena, Los Angeles County.—*a* 431 miles.

Rawson, Tehama County.—*a* 194 miles.

Raymond, Fresno County.—*a* 200 miles.

Redding, Shasta County.—*a* 234 miles.

Red Bluff, Tehama County.—*a* 199 miles.

Reeds, Yuba County.—*a* 136 miles.

Reeds, Marin County.—S. F. & N. P., 10 miles.

Redwood City, San Mateo County.—*b* 29 miles.

Reynolds Ferry, Calaveras County.—*a* to Milton, 122 miles; stage, 20 miles.

Rich Bar, Plumas County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage to Spanish Ranch, 57 miles; saddle train, 12 miles.

Richfield, Tehama County.—*a* 183 miles.

Ridgeville, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 160 miles.

Rincon, Santa Cruz County.—S. P. C., 77 miles.

Rio Vista, Solano County.—Stmr., 89 miles.

Ripon, San Joaquin County.—*a* 105 miles.

Riverside, San Bernardino County.—*a* to Colton, 540 miles; C. S., 5 miles.

Rocklin, Placer County.—*a* 112 miles.

Rhonerville, Humboldt County.—P. C. to Eureka, 216 miles; stage, 20 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage to Hydesville, 182 miles; E. R. & E. R. R. to Rhonerville.

Roseville (Junction), Placer County.—*a* 108 miles.

Ross Station, Marin County.—N. P. C., 15 miles.

Rules Landing, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 8 miles.

Rough and Ready, Nevada County.—*a* to Colfax, 144 miles; N. C. to Grass Valley, 17 miles; stage, 4 miles.

Routiers, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 12 miles.

Russells, Alameda County.—S. P. C., 19 miles.

Russian River, Sonoma County.—N. P. C., 75 miles.

Rutherford, Napa County.—*a* 60 miles.

Sacramento, Sacramento County.—*a* via Benicia, 90 miles; or Stmr., 120 miles.

Sacramento Ferry, Shasta County.—*a* to Redding, 234 miles; stage, 32 miles.

Salida, Stanislaus County.—*a* 108 miles.

Salinas, Monterey County.—*b* 118 miles; or P. C. S.

Salmon Falls, El Dorado County.—*a* to Sacramento, 90 miles; S. & P. to Folsom, 22 miles; stage, 9 miles.

Salsbury, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 16 miles.

Salmon Creek, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Hydesville, 182 miles; E. R. & E. R. R. to Salmon Creek.

Sand Cut, Monterey County.—*b* 94 miles.

Salt Point, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 25 miles.

San Andreas, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Springs, 28 miles; stage, 10 miles.

San Anselmo, Marin County.—N. P. C., 16 miles.

San Antonio, Monterey County.—*b* to Soledad, 143 miles; stage, 30 miles.

San Benito, San Benito County.—*b* to Tres Pinos, 101 miles; stage, 28 miles.

San Bernardino, San Bernardino County.—*a* to Colton, 540 miles; C. S., 3 miles.

San Bruno, San Mateo County.—*b* 14 miles.

San Buenaventura, Ventura County.—P. C., 311 miles; or *a* to Newhall, 452 miles; stage, 50 miles.

San Clemente, Marin County.—S. F. & N. P., 10 miles.

San Diego, San Diego County.—*a* to Colton, 540 miles; C. S., 121 miles; or P. C., 482 miles.

San Fernando, Los Angeles County.—*a* 461 miles.

San Dieguito, San Diego County.—*a* to Colton, 450 miles; C. S. to San Diego, 121 miles; stage, 23 miles; or P. C.

San Felipe, Santa Clara County.—*b* to Gilroy, 80 miles; stage, 10 miles.

San Gabriel, Los Angeles County.—*a* 491 miles.

San Geronimo, Marin County.—N. P. C., 24 miles.

San Gorgonio, San Bernardino County.—*a* 563 miles.

San Gregorio, San Mateo County.—*b* to San Mateo, 21 miles; stage, 26 miles; or *b* to Redwood, 29 miles; stage, 26 miles.

San José, Santa Clara County.—S. P. C., 46 miles; or *b* 50 miles; or *a* 47 miles.

San Juan, San Benito County.—*b* to Sargent's, 86 miles; stage, 6 miles.

San Juan Capistrano, Los Angeles County.—*a* to Santa Ana, 516 miles; stage, 28 miles; or P. C.

San Leandro, Alameda County.—*a* 16 miles; or S. P. C., 14 miles.

San Lorenzo, Alameda County.—S. P. C., 17 miles.

San Luis Obispo, San Luis Obispo County.—*b* to Soledad, 143 miles; stage, 114 miles; or P. C. to Port Harford, 201 miles; P. C. Ry., 11 miles.

San Luis Ranch, Merced County.—*b* to Gilroy, 80 miles; stage, 42 miles.

San Luis Rey, San Diego County.—*a* to Santa Ana, 516 miles; stage, 59 miles; or by P. C. to San Diego, 482 miles; stage, 45 miles.

San Marcos, Santa Barbara County.—*b* to Soledad, 143 miles; stage, 190 miles; or P. C. to Port Harford, 201 miles; stage, 24 miles.

San Mateo, San Mateo County.—*b* 21 miles.

San Miguel, San Luis Obispo County.—*b* to Soledad, 143 miles; stage, 78 miles; or P. C.

San Pablo, Contra Costa County.—*a* 18 miles.

San Pasqual, San Diego County.—*a* to Santa Ana, 516 miles; stage, 59 miles; or P. C. to San Diego, 482 miles; stage, 45 miles.

San Pedro, Los Angeles County.—P. C., 387 miles; or *a* 507 miles.

San Quentin, Marin County.—N. P. C., 21 miles.

San Rafael, Marin County.—N. P. C., 18 miles; or S. F. & N. P., 15 miles.

San Ramon, Contra Costa County.—*a* to Oakland, 7 miles; stage, 14 miles.

San Simeon, San Luis Obispo County.—P. C., 160 miles.

San Ysidro, Santa Clara County.—*b* to Gilroy, 80 miles; stage, 3 miles.

Sanel, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 17 miles.

Santa Ana, Los Angeles County.—*a* 516 miles.

Santa Anita, Los Angeles County, 16 miles from Los Angeles via L. A. & S. G. V. R. R.

Santa Barbara, Santa Barbara County.—P. C., 288 miles; or *a* to Newhall, 452 miles; stage, 80 miles; or *b* to Soledad, 143 miles; stage, 260 miles.

Santa Clara, Santa Clara County.—*b* 47 miles; or S. P. C., 44 miles.

Santa Cruz, Santa Cruz County.—S. P. C., 81 miles; or *b* 121 miles; or P. C., 70 miles.

Santa Paula, Ventura County.—P. C. to San Buenaventura, 311 miles; stage, 10 miles; or *a* to Newhall, 452 miles; stage, 40 miles.

Santa Inez, Santa Barbara County.—P. C. to Santa Barbara, 228 miles; stage, 40 miles.

San Margarita, San Luis Obispo County.—*b* to Soledad, 143 miles; stage 104 miles; or P. C.

Santa Maria, Santa Barbara County.—P. C. to Port Harford, 201 miles; P. C. Ry., 42 miles.

Santa Maria, San Diego County.—*a* to Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 38 miles; or P. C.

Santa Monica, Los Angeles County.—*a* 500 miles; or P. C., 361 miles.

Santa Rita, Monterey County.—*b* to Salinas, 118 miles; stage, 3 miles.

Santa Rosa, Sonoma County.—S. F. & N. P., 51 miles.

Santa Ynez, Santa Barbara County.—P. C. to Port Harford, 201 miles; P. C. Ry., 64 miles; stage, 15 miles.

Saratoga, Santa Clara County.—S. P. C. to Los Gatos, 55 miles; stage, 4 miles; or *b* to Santa Clara, 47 miles; stage, 8 miles.

Sargents, Santa Clara County.—*b* 86 miles.
Saucelito, Marin County.—N. P. C., 6 miles.
Savanna, Los Angeles County.—*a* 494 miles.
Sawyers Bar, Siskiyou County.—*a* to Delta, 272 miles; stage, 110 miles.
Scott Bar, Siskiyou County.—*a* to Delta, 272 miles; stage to Fort Jones, 65 miles; saddle train, 20 miles.
Searsville, San Mateo County.—*b* to Redwood, 29 miles; stage, 9 miles.
Sebastopol, Sonoma County.—S. F. & N. P. to Santa Rosa, 51 miles; stage, 6 miles.
Selma, Fresno County.—*a* 222 miles.
Sepulveda, Los Angeles County.—*a* 474 miles.
Selwyns, San Diego County.—*a* to Colton, 540 miles; C. S., 108 miles.
Sesma, Tehama County.—*a* 212 miles.
Seven Palms, San Diego County.—*a* 591 miles.
Seventy Mile Siding, San Diego County.—*a* to Colton, 540 miles; C. S., 56 miles.
Shady Run, Placer County.—*a* 163 miles.
Shasta, Shasta County.—*a* to Redding, 234 miles; stage, 6 miles.
Shaws Flat, Tuolumne County.—*a* to Milton, 122 miles; stage, 30 miles.
Shaws, Butte County.—*a* 191 miles.
Sheep Ranch, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 27 miles.
Shelter Cove, Mendocino County.—P. C., 167 miles.
Sheridan, Placer County.—*a* 126 miles.
Sherwood Valley, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 66 miles.
Shingle Springs, El Dorado County.—*a* to Sacramento, 90 miles; S. & P., 48 miles.
Shorb, Los Angeles County.—*a* 489 miles.
Siberia, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 141 miles.
Sierra City, Sierra County.—*a* to Marysville, 142 miles; stage, 79 miles; or *a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 57 miles.
Sierra Madre Villa, 1 mile from Lamanda Park and 13 miles from Los Angeles via Los Angeles and San Gabriel Valley R. R.
Sierraville, Sierra County.—*a* to Truckee, 209 miles; stage, 30 miles.
Signal Port, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 8 miles.
Silver Mountain, Alpine County.—*a* to Reno, 244 miles; V. & T. to Carson, 31 miles; stage, 54 miles.
Simi, Ventura County.—*a* to Newhall, 452 miles; stage, 35 miles; or P. C. to San Buenaventura, 311 miles; stage, 15 miles.
Silsby, Butte County.—*a* 169 miles.
Skaggs Springs, Sonoma County.—S. F. & N. P. to Clairville, 75 miles; stage, 8 miles.
Slate Creek, Shasta County.—*a* to Delta, 272 miles; stage, 44 miles.
Smartsville, Yuba County.—*a* to Marysville, 142 miles; stage, 18 miles.
Smiths River, Del Norte County.—Stmr, 298 miles.
Snelling, Merced County.—*a* to Merced, 152 miles; stage, 16 miles.
Sobrante, Contra Costa County.—*a* 21 miles.
Soda Bay, Lake County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Lakeport, 40 miles; stmr., 10 miles; or *a* to Calistoga, 73 miles; stage to Lakeport, 46 miles; stmr., 10 miles.
Soda Springs, Nevada County.—*a* 192 miles.

Soda Springs, Siskiyou County.—*a* to Delta, 272 miles; stage, 41 miles.
Soda Springs, Napa County.—*a* to Napa, 46 miles; stage, 7 miles.
Soledad, Monterey County.—*b* 143 miles.
Somersville, Contra Costa County.—*a* to Los Medanos, 51 miles; Pittsburg R. R., 6 miles.
Sonoma, Sonoma County.—*a* to Napa, 46 miles; stage, 15 miles; or S. V., 38 miles.
Sonoma Mills, Sonoma County.—N. P. C., 72½ miles.
Sonora, Tuolumne County.—*a* to Milton, 122 miles; stage, 35 miles.
Soquel, Santa Cruz County.—*b* 116 miles; or P. C.
Soto, Tehama County.—*a* 200 miles.
South Eel River, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 65 miles.
Southerns, Shasta County.—*a* to Delta, 272 miles; stage, 54 miles.
Spadra, Los Angeles County.—*a* 511 miles.
Spanish Dry Diggings, El Dorado County.—*a* to Auburn, 126 miles; stage, 14 miles.
Spanish Ranch, Plumas County.—*a* to Marysville, 142 miles; N. C. to Oroville, 28 miles; stage, 57 miles.
Spanishtown (Half Moon Bay), San Mateo County.—*b* to San Mateo, 21 miles; stage, 13 miles.
Spring Valley, Colusa County.—*a* to Williams, 125 miles; stage, 12 miles.
Springfield, Tuolumne County.—*a* to Milton, 122 miles; stage, 30 miles.
Springville, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Hydesville, 182 miles; E. R. & E. R. R. to Springville.
Spruce Grove, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 116 miles.
Stanfords, Nevada County.—*a* 204 miles.
Starveout, Siskiyou County.—*a* to Delta, 272 miles; stage, 165 miles.
Stege, Alameda County.—*a* 14 miles.
Steeles, San Luis Obisbo County.—P. C. to Port Harford, 201 miles; P. C. Ry., 16 miles.
Stewarts, San Diego County.—*a* to Colton, 540 miles; C. S., 85 miles.
St. Helena, Napa County.—*a* 64 miles.
St. John, Colusa County.—*a* to Williams, 125 miles; stage, 50 miles.
St. Louis, Sierra County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 51 miles.
Stockton, San Joaquin County.—*a* 92 miles.
Stock Yards, Alameda County.—*a* 9 miles.
Strawberry Valley, Siskiyou County.—*a* to Delta, 272 miles; stage, 40 miles.
Strongs, Nevada County.—*a* 203 miles.
Strongs, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 172 miles.
Sugar Pine, Tuolumne County.—*a* to Milton, 122 miles; stage, 49 miles.
Suisun, Solano County.—*a* 49 miles.
Sulphur Creek, Colusa County.—*a* to Williams, 125 miles; stage, 40 miles.
Summer Home Farm, Santa Cruz County.—S. P. C. to Glenwood, 66 miles; stage, 3 miles.
Summit, Nevada County.—*a* 195 miles.
Summit, Marin County.—N. P. O., 11 miles.
Sumner, Kern County.—*a* 314 miles.
Sunol, Alameda County.—*a* 37 miles.

Susanville, Lassen County.—*a* to Reno, 244 miles; N. & C. to Moran, 39 miles; stage, 57 miles; or *a* to Chico, 186 miles; stage, 85 miles.

Sutter Creek, Amador County.—*a* to Ione, 140 miles; stage, 12 miles.

Swansea, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C., 290 miles.

Sweetland, Nevada County.—*a* to Marysville, 142 miles; stage, 37 miles.

Sycamore, Fresno County.—*a* 197 miles.

Table Bluff, Humboldt County.—P. C. to Eureka, 219 miles; stage, 15 miles.

Tagus, Tulare County.—*a* 247 miles.

Tahoe City (Lake Tahoe), Placer County.—*a* to Truckee, 210 miles; stage, 14 miles.

Tamalpais, Marin County.—N. P. C., 14 miles.

Tamarack, Placer County.—*a* 185 miles.

Tamarack Flat, Mariposa County.—*a* to Milton, 122 miles; stage, 70 miles.

Taylorville, Plumas County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 105 miles; or *a* to Chico, 186 miles; stage, 85 miles; or *a* to Reno, 244 miles; N. & C. to Moran, 39 miles; stage, 55 miles.

Taylorville, Marin County.—N. P. C., 30 miles.

Teal, Solano County.—*a* 44 miles.

Tehachapi, Kern County.—*a* 362 miles.

Tehama, Tehama County.—*a* 187 miles.

Telegraph City, Calaveras County.—*a* to Milton, 122 miles; stage, 5 miles.

Temecula, San Diego County.—*a* to Colton, 540 miles; C. S., 49 miles.

Temescal, Alameda County.—*a* to Oakland, 8 miles; street railroad, 2 miles.

Tennants, Santa Clara County.—*b* 71 miles.

The Needles, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 240 miles.

Thompsons Flat, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 2½ miles.

Timber Cove, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 19 miles.

Timbuctoo, Yuba County.—*a* to Marysville, 142 miles; stage, 18 miles.

Tipton, Tulare County.—*a* 262 miles.

Tocaloma, Marin County.—N. P. C., 32 miles.

Todds Valley, Placer County.—*a* to Auburn, 126 miles; stage, 20 miles.

Tomales, Marin County.—N. P. C., 55 miles.

Tortuga, San Diego County.—*a* 677 miles.

Tormey, Contra Costa County.—*a* 27 miles.

Tower House, Shasta County.—*a* to Delta, 272 miles; stage, 18 miles.

Towles, Placer County—*a* 159 miles.

Town Talk, Nevada County.—*a* to Colfax, 144 miles; N. C., 20 miles.

Tracy, San Joaquin County.—*a* 72 miles.

Tres Pinos, San Benito County—*b* 100 miles.

Tremont, Solano County.—*a* 73 miles.

Trigo, San Joaquin County.—*a* 115 miles.

Trinidad, Humboldt County.—P. C., 233 miles.

Trinity Centre, Trinity County.—*a* to Delta, 272 miles; stage, 51 miles.

Trubody, Napa County.—*a* 54 miles.

Truckee, Nevada County.—*a* 209 miles.

Truitts, Sonoma County.—S. F. & N. P., 86 miles.

Tulare, Tulare County.—*a* 251 miles.
Tunnel, Los Angeles County.—*a* 456 miles.
Turlock, Stanislaus County.—*a* 127 miles.
Tuscan Springs, Tehama County.—*a* to Red Bluff, 199 miles; stage, 7 miles.
Tustin City, Los Angeles County.—*a* to Anaheim, 516 miles; stage, 7 miles.
Tuttletown, Tuolumne County.—*a* to Milton, 122 miles; stage, 26 miles.
Two Rocks, Sonoma County.—S. F. & N. P. to Petaluma, 36 miles; stage, 8 miles.
Tyler, Tehama County.—*a* 188 miles.
Tylers, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 18 miles.
Tyrone Mills, Sonoma County.—N. P. C., 74 miles.

Ukiah, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 30 miles.
Uniontown, El Dorado County.—*a* to Auburn, 126 miles; stage, 9 miles.
Upper Lake, Lake County.—*a* to Calistoga, 73 miles; stage to Lower Lake, 35 miles; stmr., 20 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage, 50 miles.

Vacaville, Solano County.—*a* to Elmira, 60 miles; V. V. & C. L., 4 miles.
Vallecito, Calaveras County.—*a* to Milton, 122 miles; stage, 29 miles.
Vallejo, Solano County.—*a*, 32 miles; or stmr., 27 miles.
Vallejo Junction, Solano County.—*a* 29 miles.
Valley Ford, Sonoma County.—N. P. C., 61 miles.
Valley Spring, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N., 28 miles.
Valona, Contra Costa County.—*a* 30 miles.
Vega, Monterey County.—*b* 96 miles.
Venada, Colusa County.—*a* to Williams, 125 miles; stage, 13 miles.
Ventura, Ventura County.—P. C., 311 miles.
Vina, Tehama County.—*a* 205 miles.
Vincent, Los Angeles County.—*a* 421 miles.
Vineland, Napa County.—*a* 63 miles.
Virginia, Placer County.—*a* to Lincoln, 119 miles; stage, 6 miles.
Visalia, Tulare County.—*a* to Goshen, 241 miles; Visalia R. R., 9 miles.
Volcano, Amador County.—*a* to Ione, 140 miles; stage, 25 miles.
Volcano Springs, San Diego County.—*a* 661 miles.

Wade, Kern County.—*a* 321 miles.
Walkers Landing, Sacramento County.—Stmr., 92 miles.
Wallace, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N., 18 miles.
Walnut Creek, Contra Costa County.—*a* or S. P. C. to Oakland, 8 miles; stage, 17 miles.
Walnut Grove, Napa County.—*a* 70 miles.
Walters, San Diego County.—*a* 625 miles.
Walthall, San Joaquin County.—*a* 101 miles.
Warm Springs, Alameda County.—*a* 37 miles.
Warners Ranch, San Diego County.—*a* to Colton, 540 miles; and C. S. to San Diego, 121 miles; stage, 60 miles; or P. C.
Washington, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 21 miles.

Washington, Yolo County.—*a* 90 miles.
Washington Corners, Alameda County.—*a* 34 miles.
Waterloo, San Joaquin County.—*a* to Stockton, 92 miles; stage, 10 miles.
Waterman, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 70 miles.
Watsonville, Santa Cruz County.—*b* 101 miles.
Waverly, San Joaquin County.—*a* 114 miles.
Webster, Yolo County.—*a* 81 miles.
Weaverville, Trinity County.—*a* to Delta, 272 miles; stage, 46 miles.
Webbs Landing, Contra Costa County.—Stmr., 53 miles.
Webber Lake, Sierra County.—*a* to Truckee, 209 miles; stage, 24 miles.
Westport, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 95 miles.; or N. P. C. to Duncan Mills, 79 miles; stage, 125 miles.
West Berkeley, Alameda County.—*a* 10 miles.
West Oakland, Alameda County.—*a* 6 miles.
West Point, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 29 miles.
Wheatland, Yuba County.—*a* 130 miles.
Westminster, Los Angeles County.—*a* to Anaheim, 509 miles; stage, 4 miles; or P. C.
Whisky Hill, Santa Cruz County.—*b* to Watsonville, 101 miles; stage, 2 miles.
Whitelys Ford, Modoc County.—*a* to Delta, 272 miles; stage, 135 miles.
Whitehall, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 15 miles.
Whitneys, Sutter County.—*a* 114 miles.
White Rock, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 29 miles.
White Sulphur Springs, Napa County.—*a* to St. Helena, 64 miles; stage, 3 miles.
Whitewater, San Diego County.—*a* 583 miles.
Whitesboro, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; N. P. C. to Duncan Mills, 79 miles; stage, 87 miles; or P. C.
Wilburs Hot Springs, Colusa County.—See Sulphur Creek.
Williams, Colusa County.—*a* 125 miles.
Williamsons, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 14 miles.
Willits, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 54 miles.
Willmore, Los Angeles County.—*a* 500 miles.
Willows, Colusa County.—*a* 151 miles.
Wilmington, Los Angeles County.—P. C., 392 miles; or *a* 504 miles.
Windsor, Sonoma County.—S. F. & N. P., 60 miles.
Winters, Yolo County.—*a* to Elmira, 60 miles; V. V. & C. L., 17 miles.
Woodbridge, San Joaquin County.—*a* to Lodi, 104 miles; S. J. & S. N., 3 miles.
Woodfords, Alpine County.—*a* to Reno, 244 miles; V. & T. to Carson, 31 miles; stage, 30 miles.
Woodland, Yolo County.—*a* 86 miles.
Woodside, San Mateo County.—*b* to Redwood, 29 miles; stage, 6 miles.
Woodville, Tulare County.—*a* to Goshen, 241 miles; V. to Visalia, 7 miles.
Woolseys Flat, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 16 miles.
Wrights, Santa Clara County.—S. P. C., 62 miles.

Wrights Hotel, Santa Clara County.—S. P. C., to Wrights, 63 miles; stage, 2 miles.

Wyandotte, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 6 miles.

Yankee Hill, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 18 miles.

Yankee Jims, Placer County.—*a* to Auburn, 126 miles; stage, 18 miles.

Yorkville, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 20 miles.

Yosemite Valley, Mariposa County.—*a* to Raymond (end of new Yosemite extension), 200 miles; stage via Mariposa Big Trees, 60 miles; or *a* to Milton via Stockton, 143 miles; stage, 85 miles.

Yolo, Yolo County.—*a* 91 miles.

You Bet, Nevada County.—*a* to Dutch Flat, 157 miles; stage, 7 miles.

Yountville, Napa County.—*a* 55 miles.

Yreka, Siskiyou County.—*a* to Delta, 272 miles; stage, 115 miles.

Ysidora, San Diego County.—*a* to Colton, 540 miles; C. S., 75 miles.

Yuba City, Sutter County.—*a* 141 miles.

Yucca, Kern County.—*a* to Mojave, 382 miles; A. & P., 20 miles.

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FIRST BIENNIAL REPORT

OF THE

California State Board of Forestry,

FOR

THE YEARS 1885-86,

TO GOVERNOR GEORGE STONEMAN.

MADE IN ACCORDANCE WITH THE PROVISIONS OF SECTION FIVE OF AN ACT "TO CREATE A STATE BOARD OF FORESTRY, AND TO PROVIDE FOR THE EXPENSES THEREOF," APPROVED MARCH 3, 1885.

SACRAMENTO:
STATE OFFICE........JAMES J. AYERS, SUPT. STATE PRINTING.
1886.

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REPORT

OF THE

CALIFORNIA STATE BOARD OF FORESTRY.

To his Excellency George Stoneman, *Governor of California:*

The State Board of Forestry has the honor to present its first biennial report showing the progress and condition of our work. The separate reports of the Forestry Commissioners, of our efficient Secretary, of our Engineer, and of other gentlemen, will show what has been and what is being done in the line of our duty.

We have an Engineer now in the field ascertaining the condition of the forests throughout the State, the amount of damage done by waste and fire, and the effects of denudation upon the climate and watercourses. The partial report and forest map of our Engineer, Mr. Hubert Vischer, are herewith submitted. Mr. Luther Wagoner, Mining Engineer, has traced the present line of saw timber in Amador, Calaveras, Tuolumne, and Mariposa Counties, and reported on these counties to the Board, his report being annexed. Dr. A. Kellogg, of the Board, has prepared a valuable partial list of the trees and shrubs of the State. Mr. Abbot Kinney sends a report accompanying the forest maps of Los Angeles, San Bernardino, and San Diego Counties. · He calls attention to the serious results of forest fires and forest denudation that have recently taken place in Southern California. It is of the greatest importance that the people, as represented by their legislators, should understand that the prosperity and tax-paying power of a large portion of California can only be maintained by a preservation of the mountain watersheds.

Civilization throughout the world has recognized this fact, and provided forest departments principally to preserve the climate and watersheds of their lands. Other important functions have been added, such as providing a permanent supply of lumber, fuel, tanning bark, etc.

We have found much sympathy and support throughout the State from private individuals.

The forest maps of San Diego and San Bernardino we owe to the volunteer work of Mr. John E. Jackson. The map of San Diego County is the volunteer work of Mr. T. S. Van Dyke and Mr. M. G. Wheeler. The very valuable report on the forests of San Diego County, by Mr. C. R. Orcutt, is also a volunteer work, contributed without any charge. We take this opportunity of thanking these gentlemen for their generous public spirit.

A movement has also been inaugurated in San Francisco for the setting apart of a day for tree-planting in California. This movement is headed by such influential citizens as Joaquin Miller, Adolph Sutro, Gen. O. O. Howard, and others equally prominent. We are heartily in favor of the movement, and hope that these gentlemen will continue their good work.

Our Board has distributed notices, against setting fires, through many portions of the State. The notice sets forth the penalty of violation of the

law in this regard, and has done much good. We are glad to report that the fires, especially through the mountains in Southern California, have been fewer and less destructive than usual.

At our instigation, special agents of the Land Office have examined into numerous cases of violation of the law, through setting fires in the forests and the unauthorized cutting of timber on the public domain. We hope to accomplish much good in this way.

The following is a copy of the circular letter sent out through the State, designed to create a greater interest in forestry, and impress upon the minds of the people the vital importance of the subject. It is believed to have well served its purpose:

OFFICE OF STATE BOARD OF FORESTRY, ROOM NO. 42,
NEVADA BLOCK, SAN FRANCISCO, CAL.

To the Citizens of California, and especially to the Farmers and Irrigators:

We earnestly call your attention to the following statement of your interests:

The forests of California are confined principally to mountain lands. These mountain forest lands are for the most part so steep and rocky as to be forever unprofitable in agriculture.

Their use, then, is and must be, the production of timber and fuel.

The climate of California, unique in its charms, has as its chief peculiarity a dry and a wet season. The forests of the State cause the rainfall to come more evenly and regularly than would be the case were the forests destroyed. They oppose impediments to the rapid flow of surface water, and thus mitigate floods and allow the rainfall to seep into the soil and veins of rock, to appear again as springs and streams in which water is provided for the long dry season.

Forests also modify and lessen violent winds and extremes of temperature, and of humidity.

It is, therefore, of interest to the citizens of California, that our forests should be maintained as to their reproductive power in timber and fuel, and it is of vital interest to the farmers and irrigators that the integrity and life of the springs and streams should be protected.

Wasteful and destructive methods of cutting the timber now prevail, and no regard is paid to the reproductive power of the forests.

Great and increasing damage is done every year by fire.

The present land laws of the United States are so ill-suited to the timber interest as to invite frauds. These frauds have grown to be the disgrace and reproach of the Government land system. In the forests of California the Government has a property of great value, not only directly, but indirectly, through the need of the forests and streams to maintain the tax-paying capacity of the people.

For this great property the Government has no care. No watch is set to prevent the depredations; no thought is taken nor action had to keep up its usefulness. The State school lands in forest, Sections 16 and 36 in every township, have also been most sadly neglected, and the school property wasted and destroyed.

For these reasons, the California State Board of Forestry believe that the Congress and Government of the United States should withdraw all the Government timber lands in the State of California from sale or entry.

To maintain such of these lands permanently in forest as shall be deemed necessary for the welfare of the State, and to guarantee the verdure on the watersheds so as to preserve the springs and streams, and to prevent the creation of destructive torrents injurious to the farm and valley lands.

Such forest reservation should be guarded from fire and depredation. The cutting of timber and fuel should be regulated in such a reasonable way as will preserve the reproductive capacity of the forests, and neither endanger the climate nor the springs and streams.

The expense of such care to be derived from a charge on the cutters of timber and fuel.

We also ask the aid of all citizens in preserving the State school lands in forest from timber thieves and fires.

The climatic conditions of California are so different from those of the other States, its forest area is so peculiarly limited to its non-arable lands, and its agriculture is so largely dependent on the maintenance of the water supply, that more than ordinary importance must be attached to the preservation of the forest and brush lands of the State. We therefore most earnestly ask the citizens of California to furnish us with any and all information they may have relating to this subject, and to aid us in bringing to judgment the depredators and wasters of the people's property.

The importance of the lumber industry is fully recognized. We have no idea, in any of our work or recommendations, to hamper this industry. But we believe that the land laws under which the lumbermen work are

so cumbersome and inappropriate as to invite fraud, and to injure those honestly endeavoring to obey them. In our opinion no more sales should be made of Government or State timber land not fit for agriculture. Such lands should be permanently reserved from sale and the control of the cutting of the timber placed in the hands of national or State forestry officers. The cost of license to cut timber should at least cover the cost of the supervision and care of the forests by its guardians. In this way the timber and fuel supply can be maintained without the injury and destruction of the forest that now attends these necessary industries. At the same time all improper denudation of watersheds whereby streams or springs are dried up, or destructive torrents formed, will be prevented. The people need have no fear that a properly organized forestry department will prove expensive. In every country where such departments exist a net revenue is turned by them into the public treasury. We do not expect our organization to be made complete and self-sustaining at once, but we desire to have our hands strengthened in some directions as soon as possible.

In this connection it will not be out of place to reproduce a petition which has been circulated and extensively signed by many of the most influential residents of the southern part of the State. It is as follows:

A Petition to the State Board of Forest Commissionsers,

To prevent parties and persons from securing mountainous government lands, in the County of Los Angeles and State of California, for the purpose of cutting and removing the timber thereon.

To Abbot Kinney, *Esq., Member of the Board of Forest Commissioners, State of California:*

Whereas, It has come to the knowledge of the undersigned, that mountainous government lands in this vicinity are being appropriated by several parties; and believing it to be their intention to remove the trees and timber thereon, we, the undersigned irrigators in the San Gabriel Valley, respectfully call your attention to this fact. We believe that it will seriously interfere with and destroy the springs and watercourses in said mountains, the waters of which are used to irrigate the plains and valleys below.

Therefore, we respectfully petition you to use what influence and authority you can to stop the devastation of said forests, to the detriment and great injury of the irrigators and land below. This petition does not propose to interfere with parties taking up lands for other purposes than above set forth. We would also suggest that appropriate signs, with penalties attached, calling attention to the necessity of the careful use of fires in the mountains, be put in conspicuous places on all roads and trails.

The present fires that desolate the forests of California are a violation of law and are exceedingly destructive to public property. After continued earnest effort, in many cases with legal advice at our own private expense, we are obliged to report that we cannot arrest nor convict these fire-setters without the assistance of special officers, who can be sent into the mountains to secure evidence and find the depredators.

We herewith hand in several bills, the passage of which will enable us to encourage tree planting, and will assist us in protecting existing forests, at least from waste and useless destruction. We will also be able to complete the valuable forestry map and report now in progress, and provide forest guards.

Our Board has been in correspondence with the forest departments of other nations. By this means we have been able to furnish individuals throughout the State, desiring to plant trees, with useful information and the results of others' experiments. We desire to call attention in this connection, to the value of the *Acacia decurrens*, or black wattle, and, for very dry lands, of the *A. pycnantha*, or broad-leafed wattle, as producers of tannin. The results of a plantation of one hundred acres in South Australia of the *Acacia decurrens*, for tannin alone, at the end of seven years was $5,540 clear profit. The seed pods of this plant when green, and even after they are dry,

form an excellent substitute for soap—among the population here where the tree is known, these pods are considered the best material for washing all woolen goods. The stripped trees would here be valuable as firewood, and add to the profit. This tree reproduces itself naturally in California, and grows readily and quickly on poor lands almost everywhere in this State. It is, however, subject to scale pests where these exist. Our native sumacs contain considerable tannin. We are having them analyzed to find if the tannin is in sufficient quantity to justify the planting of these shrubs for profit. Considerable quantities of sumac tannin are imported into this country from Italy, which can doubtless be supplanted by a home-grown product, taken either from the native sumac or from those of Italy, which are equally well suited to our climate.

The most rapid grower and the tree giving the promptest return, when planted in favorable locations, is the *Eucalyptus globulus*, or Tasmanian blue gum. This tree is a native of Tasmania, which has a comparatively moist climate, with a rainfall of about twenty-five inches. This tree, therefore, does well where the air is moist, as upon the coast hills, or upon lands in the interior where the water is not too far from the surface. Like all the Australian trees, it will not stand long continued low temperature. It has proved a profitable tree as a fuel producer in the southern part of the San Joaquin Valley and in all the southern counties of the State, and it has done well wherever planted near the coast. It has been utilized thus far almost exclusively for fuel. Extensive plantations by Mr. Remi Nadeau and the Messrs. Beaudry, of Los Angeles, and Mr. Ellwood Cooper, of Santa Barbara, have proved very satisfactory. This tree, however, has its limitations, and does not do well in dry soils removed from the moist influence of the sea. Experiments made by the Chairman of the Board, on sandy lands at the foot of the Sierra Madre Range, in Los Angeles County, show this tree to be practically worthless in such locations. Extensive experiments in South Australia show that where the Tasmania blue gum fails, owing to excessive dryness, other and better trees, although of not so rapid growth, succeed well.

Trees that we are able to recommend for dry situations are: *E. corynocalyx*, or sugar gum; *E. leucoxylon*, or Australian blue gum; the *E. calophylla*, or red gum of West Australia; *E. rostrata*, or red gum of South Australia; the *E. siderophloia*, or red iron bark of New South Wales. The first two of these are probably the best.

The *Pinus pinea*, or stone pine, seems to be the coniferous tree best suited to dry locations of small elevation. *Pinus insignis* and *P. pinaster* also do well. *Catalpa speciosa* is a valuable timber tree, which will grow well in situations suited to the *E. globulus*.

The American white ash, the black walnut, and the black locust are valuable timber trees which have done well, singly and in small groves, in various parts of the State; but we have not sufficient data to recommend large plantations of them. Experiments by Professor E. Hilgard, at Berkeley, and plantations in Australia, show that the English oak (*Quercus pedunculata*) is a more rapid grower than our native oaks, and is therefore suitable to mix in tree plantations. Our own tanbark oak, which is very valuable, does well in damp situations near the coast. We would like to suggest here, to persons growing trees for tanbark, that experiments in Ceylon, in India, with the cinchona tree, show the advantage of not stripping the entire bark and killing the tree at once. Formerly this was the universal custom in cinchona plantations; now only portions of the bark are taken, the tree remaining alive and producing continuous crops, to the great profit of the planters. Another point that we desire to call attention to is,

that the experience of all the Forest Departments with which we are familiar, show that mixed plantations of trees do much better, as a rule, than plantations of one variety only. Certain trees grow better together than others, which makes the subject one requiring considerable scientific study. There should be several experimental stations, situated in the different climatic belts in the State, where the growing qualities of trees in our various climates can be tested. The University at Berkeley has thus far done an excellent work in this respect for that locality.

We have lands offered to us in several parts of the State, if we had funds to utilize them.

Much of the school land granted by the Government to the State for school purposes is in timber. A large portion of this land is of such a character as to be worthless for anything except timber. Reports from special agents of the United States Land Office show that considerable amounts of the school lands have been stripped of their timber, in violation of the law. Our attorney is now prosecuting one such case in the central part of the State.

We believe that the school lands in forest can be made a perpetual source of income for the schools and the forests still maintained on them. We therefore recommend that no further sales of these lands be made until the Engineer of the Board shall have reported upon their character; and such of these lands as shall be found to be useless for agriculture shall be permanently reserved and placed under the hands of proper officers for the benefit of the schools.

We are glad to be able to report that our Board is in perfect accord with the Forest Division at Washington, and with the resolutions adopted by the National Forestry Congress at Denver, in regard to the reservation from sale of all government forest lands not suitable for agriculture. As we have before said, the land laws governing the disposition of government timber lands are far from satisfactory and ought to be changed, if not as we suggest, in some other way. Much of this land is taken up, stripped of its timber, and abandoned. All such lands escheating to the State should, in our opinion, be placed under the control of proper officers.

One of the difficulties that forestry has to contend with in widening its sphere of usefulness is the scarcity of men acquainted with its practical details. At the suggestion of this Board, the University of Southern California at Los Angeles has inaugurated a School of Forestry, where forestry will be taught, and this want, at least, partially supplied. If this school is carried on as it has been planned, it will be of great value, and will be the only complete forestry school in the United States. We hope that the University of California at Berkeley will advance the great interest of forestry in the same way.

Part of our work should be the sending out of bulletins, from time to time, both for the purpose of giving information and of educating the people in forestry, so that they will know how to utilize forest lands owned by them to the best advantage. We also desire to make more complete collections of seeds of the native growths. These have been too much neglected in our State. In California grow some of the most valuable timber trees of the world.

The seeds of our trees are in considerable demand in foreign countries. For those that we send abroad we obtain in exchange the seeds of valuable growths of other countries.

In looking over the reports of the Engineers and Secretary of the Board, and of the volunteers who have contributed so much to make our report valuable and interesting, several points of general interest claim attention.

The redwood region is sketched out by our Engineer. He shows what is going on in that district, how the land laws work, and the immense importance of this lumber to California. This is undoubtedly the most valuable block of timber now standing in the world.

The present cutting of timber in California is no fair measure of what it is likely to be. The forests of the Eastern States and the great pineries of Michigan and Wisconsin are rapidly becoming exhausted. On the other hand the demand for lumber is as rapidly increasing.

The eyes of the lumbermen of the East are turning toward California for their next field of operations. We are credibly informed of several large eastern and foreign corporations who intend to exploit our forests. Now is the time to inaugurate a system by which the lumber industry may be carried on without the present temptations to violate law, and without injury to the climate and to the great farming interests of the State. The destruction in the forests caused by injudicious pasturage is very great. Complaint on this score is general in all mountainous parts of the State. Pasture exists in the mountains and among the forests. Under the European forestry system, similar pastures are used to their fullest extent. This we believe should be the case here also, but the present unregulated and irresponsible methods are bad, not only for the forests but for those utilizing the pastures.

No fact is better established than that improper pasturage, especially by sheep, kills out the useful fodder plants and all young growths of trees. The ground is unduly packed, floods become common and disastrous, and the soil in the end is washed from the mountains, thus making them worthless for all purposes. The example of Provence and Spain, where the merino sheep originated, show that the careless cutting of trees, the burning of the upper hills to improve pasture, and their overstocking with sheep, completely destroyed the entire mountain pastures of those countries. The secondary results were a desiccation and desolation of the agricultural lands, and a progressive diminution of the taxpaying power of the communities. In Provence these unfortunate events went on, accompanied by a decreasing population, whilst the rest of France was prosperously advancing in both these respects. We therefore think measures should be gradually introduced which should regard the large interests at stake with a view to improving the methods of utilizing our mountain pastures.

The State Board of Forestry of California desires it to be clearly understood, that they do not wish to interfere with or unduly vex any of the industries of the State connected with forestry. On the contrary, we believe that these interests can be best maintained and protected by proper and reasonable forestry regulations.

It is clear, from the reports referred to, that the interests of this State as to forestry are very different in its varying climatic and topographical belts. In the northern portions we find the forest covering a larger proportion of land than is considered necessary for the best interests of agriculture and climate. In this region we also find the forests strong in their power of self-perpetuation. So that the duties of a forester would largely consist in protecting and thinning out the new growths so as to make them commercially valuable. This is not generally the case in the new growths now; these come up too thick to promise a future value. As we go south, however, the air becomes drier, the rainfall less, the value of the springs and streams becomes greater, and the forests upon which these so largely depend, grow less and less, and their reproductive power grows weaker and weaker. In the south and east of the Sierras the trees once cut do not generally grow again. Fires in the brush, two or three times repeated, will leave their

bare scars on the mountains for years. As an illustration of this, the forest cut off on the east side of the Sierra, near Truckee, has left bare and rocky mountains in place of the former verdure. The stumps of the trees, cut by the Mission Fathers on the Sierra Madre, in the south, and the burnt remains of others, now stand in their chaparral without any prospect of new forest growth. It is from this cause that a fire which, in the extreme north, is considered a venial offense, is, in the south, deemed a crime against God and man.

In the north there is much land covered by forest that might with advantage be cleared and used for agriculture, but in the south the proportion of forest is far less than it should be. The larger part of this quarter of the State is absolute desert. The dry hot winds originating on these deserts would certainly destroy all vegetation upon the fertile lands, were it not for the forests and mountains that intervene. In the north the streams are not used to any extent for irrigation, but in the south the springs and streams are the life of the land.

The destruction of the forests in the southern counties means the destruction of the streams, and that means the destruction of the country. The State Board does not overlook these great differences, but hopes and intends to make its measures useful and satisfactory to all sections. To those who would like to inform themselves of the terrible results of forest denudation, we would suggest "The Earth as Modified by Human Action," by George P. Marsh, formerly United States Minister to Italy, and "Forests and Moisture," by John Croumbie Brown, LL.D., published in Edinburgh. These works are very interesting, and being the result of years of investigation, are well worthy of the study of the statesman.

Mr. Wagoner, in his report, alludes to the opinion of some old settlers, that the cutting of trees upon the immediate banks of some of the streams in the north either actually increased the flow of those below, or did not diminish it. This sometimes occurs, particularly in moist or cloudy countries where the direct evaporation caused by the sun is not great. The effect where produced is caused by the detention of the stream by tree roots, and the diffusion into the air by the leaves of the water taken up by the trees themselves. We mention this because an instance of this kind might confuse the opinions of those not understanding the phenomena. In mountains, the number of actual cubic feet of water delivered annually under the same rainfall from a watershed, is undoubtedly less when forested than when bare; but the advantage of the forest is, that it attracts the moisture and holds and detains the rainfall so that it flows off in a slow and gentle manner, either by the streams or by springs caused by the water's seeping through rock veins. But the bare watershed throws off all the rainfall at once in one great destructive flood, carrying before it rocks, gravel, soil, and everything; with these it ruins the valley lands below. Nothing illustrates these effects better than the fact that the heavy rains of the coast counties, falling upon forested mountains, run off in well defined channels, and seldom, if ever, cause destructive floods; whereas, the very light rainfall of the Colorado Desert, seldom over four inches per annum, and often not two, falling on perfectly bare mountains, covers the whole country with a sheet of rushing water, and washes away miles of railroad track at a time. We believe that there is nothing more important to the welfare of this commonwealth than the preservation of its splendid forests.

ABBOT KINNEY,
JAMES V. COLEMAN,
A. KELLOGG,
State Board of Forestry.

REPORT OF THE SECRETARY.

San Francisco, Cal., November 1, 1886.
Room No. 42, Nevada Block.

To the State Board of Forestry:

I have the honor to submit the following report, made under the direction of the Forest Commissioners of California. It sets forth the origin and organization of the State Board of Forestry, and an account of that portion of its work coming most directly under my supervision. The Act "to create a State Board of Forestry and to provide for the expenses thereof," under which the present Commission is operating, was approved March 3, 1885, and is as follows:

The People of the State of California, represented in Senate and Assembly, do enact as follows:

Section 1. There shall be established a State Board of Forestry, consisting of three persons appointed by the Governor of the State.

Sec. 2. Each member shall hold office for the term of four years, and until his successor shall be qualified.

Sec. 3. The Board may appoint and prescribe the duties of its Secretary, and elect one of its own members Treasurer, both to hold office at the pleasure of the Board.

Sec. 4. The duty of the Board shall be to collect statistics and other information with regard to forestry, tree culture, and tree preservation, throughout the State; to correspond with various forestry societies and individuals, for the purpose of obtaining such information; to learn by investigation and experiments the adaptability of various trees to the different sections of the State; to disseminate such information throughout the State in such a manner as to aid and encourage the purpose for which this Board is formed; to assist in enforcing and carrying out all national and State forestry laws, as far as practicable; to act with a special view to the continuance of water sources that may be affected in any measure by the destruction of forests near such sources; to do any and all things within their power to encourage the preservation and planting of forests, and the consequent maintenance of the water sources of the State.

Sec. 5. This Board shall report biennially to the Governor a detailed statement of its work, which shall include all disbursements that may have been made. All printing required to be done by the Board for their official use shall be done by the Superintendent of State Printing.

Sec. 6. There is hereby appropriated for the use of this Board, out of any moneys in the State Treasury not otherwise appropriated, the sum of five thousand ($5,000) dollars for the two years beginning the first of April, eighteen hundred and eighty-five; said sum to be used for the payment of the salary of the Secretary, not to exceed the sum of one hundred and twenty-five dollars per month, the necessary traveling expenses of the members of this Board, the employment of assistants, and such other needful expenditures as this Board may incur, and the State Controller will draw his warrants on the State Treasurer in favor of the Treasurer of the Board for the same.

Sec. 7. The members of this Board shall receive no compensation.

Sec. 8. All Acts or parts of Acts in conflict with this Act are hereby repealed.

On the first day of April, 1885, the following named gentlemen whom his Excellency the Governor had been pleased to appoint Commissioners, under the Act, viz.: Honorable James V. Coleman, Chas. M. Chase, and Dr. A. Kellogg, met at the rooms of the Academy of Sciences, in San Francisco, and proceeded to organize the California State Board of Forestry. Mr. Coleman was elected Chairman, Mr. Chase, Treasurer, and Sands W. Forman, Secretary. In the month of May, 1886, Mr. Chase resigned as a member of the Board, and the vacancy was filled by the appointment of Honorable Abbot Kinney, of Los Angeles. The Board then reorganized by the

election of Mr. Kinney as Chairman, vice Mr. Coleman, resigned, Dr. Kellogg, as Treasurer, the office of Secretary remaining as before.

The first work of the Commission, after this reorganization, was the sending out of circulars asking information concerning the condition of forest and timber lands throughout the State, the quantity and quality of wood cut or left standing, its commercial and domestic uses and value, and requesting suggestions for the encouragement of tree planting, and the prevention of forest fires. It is to be explained that, although these circulars were sent to the County Clerk of every county in the State, and to private individuals, who, it was thought, would interest themselves in the subject, answers were received to barely one fourth of them. This, perhaps, may be attributed to the fact that the questions put, in order to be properly answered, required investigation and research, which few had time to give, and it may have been that to those living in the midst of great primeval forests, where the axe of the woodman and the surge of devastating flames have not yet done irremediable damage, the importance of replying to our inquiries did not sufficiently commend itself. Or we may, perhaps, attribute their silence to this: that even now, too many consider the timber resources of our great State well nigh inexhaustible, or at least a subject that need only vex the minds of generations yet to come. The direful effects of the denudation of vast timber tracts which have made their appearance in older States, are comparative strangers to the people of the Pacific Slope, but so surely as the decline of countries and peoples, both modern and ancient, may, in many cases, be laid to this cause (and instances are too frequent and self-convincing for contradiction), so surely will this great commonwealth in time be made to feel these same effects, if some means be not taken to check the useless and too often reckless felling of our forests.

Although, as has been said, Forestry is to our people a comparatively new subject, yet the baneful results of injudiciously denuding the bosom of mother earth have most cruelly forced themselves upon mankind for ages past, and led to the framing of restrictive laws, and laws for the encouragement of tree planting, which we may study to our profit. The highest officers in the land were often made the custodians of the forests, and in the far away Empire of Japan a law has been in existence from the earliest times providing that where a tree has been cut down, another was to be planted in its place. The ancient Germans had also a law which provided that all trees to be felled should be marked by a competent forester, and the unlawful felling of a tree was often punished with death. But notwithstanding these safeguards, man's selfishness, recklessness, and ignorance combined to destroy and ruin vast tracts of wooded land which should have been left as a heritage for future generations. Republics are prone to live for the day, and let the coming man look out for himself. Our own is no exception to this rule, and it would seem that we dwellers on the Pacific Slope are, perhaps, more reckless than others in this respect. The State Board of Forestry, however, does not need to call the attention of those now living, to the claims of generations to come, in order to explain the importance of tree preservation and culture. The men and women of to-day are vitally concerned in this subject, and it will require but a few speeding years, at the rate at which our timber lands are being denuded, to bring home to our doors the same disastrous results which have made desolate and sterile lands that were once as fertile as our own.

It is hardly necessary to refer to the many notable instances of wreck and ruin that have resulted from the indiscriminate and injudicious felling of forests. Countries that were once densely populated, fertile and pros-

perous, are to-day but thinly settled, sterile and bleak, the result of the improvidence and ignorance of man. Look at the state of the countries of western Asia, northern Africa, and southern Europe as compared with their condition in days gone by when their peoples ruled the world and the products of their soil found ready market in every port where their argosies sought anchorage. It is more than lamentable to compare the present physical condition of these countries with the accounts given by historians of their former greatness, their fields of cereals that waved their golden treasures in every nodding breeze, their glorious agriculture that was their pride and the envy of their neighbors. All this has been long a thing of the past. The cumulation of ages of toil has been given over to desolation, and great tracts that once bloomed and blossomed are now devoid of commerce, art, or agriculture. Their great life-giving forests are no more; the virgin earth has been swept away, and the once fruitful meadows that gave occupation and food to a thrifty, if reckless people, are now but a waste, because the water supply that once had nourished them has vanished with the trees that stood upon the watersheds of the running streams.

It is not proposed to go here into explanation of the effects which the forests have upon the springs and water sources; their timely holding of the snows upon the mountain tops and sides; their ameliorating influence upon climate; their thousand and one benefits that the animal and vegetable kingdom must be thankful for. All these have been already so well set forth, so conclusively proven by the greatest scientists of the day, so often and so clearly brought to the attention of the reading public, that the task of repetition would be as thankless as unneeded. It will not be necessary to recall in detail the laws that other nations have passed restrictive and otherwise, for it must be conceded that those which now prevail throughout the different States are modeled for the most part after them, but it will not be out of place to summarize those that our sister States have adopted, that we may see how far their needs are like to ours, and profit by their experience in what our own laws may be lacking. Space forbids the giving of more than the prominent points in the forestry laws that find place in their statute books.

WHAT THE STATES HAVE DONE.

California—For willfully setting fire to any wooded country or forest belonging to the State or Federal Government, or to any place where fire would communicate to such forests, a penalty of not more than $1,000, or a term of imprisonment, not more than one year, is imposed. A Forestry Commission was appointed in 1885—whose objects and duties are defined in the Act printed in another place.

Colorado—Provides that the General Assembly shall enact laws in order to prevent the destruction of, and keeping in good preservation, the forests upon the lands of the State or government, the control of which shall be conferred upon the State by Congress. A Forest Commissioner is appointed who has the care of all public wood lands, to prevent trespass, the starting of fires, and to see to the conservation of forest growth. The County Commissioners are enjoined to encourage the planting of trees along watercourses and ditches. Persons are made liable, in triple damages, for injuries to trees, and the increased value of land from tree planting is not to be assessed for a period of ten years from planting; a premium is also offered for six consecutive years, for every one hundred forest trees planted along irrigating ditches.

Connecticut—In 1877, a law was passed to encourage tree planting, which provides that planted wood lands, which at the time of planting were not worth more than $15 per acre, shall be exempt from taxation for a period of ten years. By an Act of 1881, a bounty was offered for planting trees along the highway.

Dakota—Parties planting trees along public highways may occupy and use one rod in width of such highways for the purpose of cultivating the growth of timber and trees thereon.

Illinois—Counties are allowed to offer as bounty, to persons planting forest trees and caring for them three years, any sum not exceeding $10 per annum for three years, for each acre so planted.

Iowa—Passed an Act in 1868, exempting from taxation the real and personal property of each taxpayer, who should plant and cultivate one or more acres of forest trees for timber, to the amount of $100 for ten years, for each acre so planted and cultivated.

Kansas—In 1868 had a law giving a bounty of $2 per acre for planting any kind of forest trees, except black locust, to continue for twenty-five years. This was amended in 1872, requiring at least one hundred and sixty trees to the acre. Two years later this Act was repealed, and one enacted providing penalties for kindling fires upon lands not owned and occupied, leaving the same unextinguished.

Maine—Exempts from taxation, for twenty years, lands from which the primitive forests have been removed, that are reset to trees.

Minnesota—An annual bounty of $2 per acre, and a like annual bounty for every half mile of trees along the public highway, to be paid out of the State Treasury.

Missouri—A similar law exists, except that the bounty is paid by the county in which the trees are planted.

Nebraska—An exemption of $100 per year, for five years, on each acre planted, and a further provision that the increased value of land by reason of live fences, fruit and forest trees grown thereon, shall not be taken into account in the assessment thereof.

Massachusetts—Provides that the agricultural societies shall offer premiums at their discretion for the raising and preserving of oaks and other trees best adapted to perpetuate a supply of ship timber. Also encourages the formation of societies for the purpose of improving streets and public squares, by planting ornamental trees thereon. In 1882, the State passed an Act authorizing towns and cities to provide for the preservation and reproduction of forests.

New Hampshire—Passed an Act in 1881, appointing a State Board of Forestry, to inquire as to the destruction of forests, the effect of forests on rainfall, and the condition of streams, and in regard to the wisdom or necessity for forestry laws. Towns are also empowered to raise money to set out shade trees and abate taxes to persons who do so.

Nevada—An annual bounty of $10 per acre and $10 per half mile, along public highways, for twenty years, paid by the county, and such planting not to add to or increase the taxable value of said land. The Act does not apply to willows or cottonwoods planted along canals for the protection of the banks.

New York—Allows overseers of highways to give a rebate of $1 for every four trees set out along the highways; has also appointed a Forest Commission, to which are given extensive powers of control over all the public lands of the State. Provision is made for introducing forestry into the schools, and for publishing tracts and circulars on trees and tree planting. Effective laws have also been passed for the protection of forests from fire.

Ohio—Passed an Act in 1882, establishing an Agricultural Experimental Station. Part of the operations are to be the planting and testing of trees in an arboretum, and the encouragement of tree planting throughout the State. Later a Forestry Bureau was established in connection with the State University at Columbus. This bureau is now engaged in establishing forestry experimental stations.

Vermont—In 1882 appointed Commissioner "to inquire into the subject of the forests of Vermont, as to their extent and condition, and as to what, if any, measures should be taken in respect to their preservation." The report of the Commission made many recommendations for the better protection of forests, which will ultimately be made legal enactments.

Wisconsin—Exempts from taxation lands set to belts of trees until they attain a height of twelve feet; afterward the owner of such tree belts is entitled to an annual bounty of $2 per acre. These tree belts, it is provided shall be on the west and south side of tracts of land, and not less than thirty feet wide for each five acres of land.

COUNTY REPORTS.

The following is a copy of "Inquiries" prepared by the State Board of Forestry and forwarded to every county in the State, and although answers were received, as has been stated, to barely one fourth of them, yet from the fact that the northernmost and southernmost, as well as many of the intermediate districts, have been heard from, the results may be considered partially satisfactory and the information gained worthy of publication. Some replies, it is true, were returned, which possessed little or no value, and these have been omitted.

INQUIRIES.

No. 1. State to what extent the native forests in your county have been cut off, and what kind of timber is left standing, and to what uses it is adapted?

No. 2. State for what purposes the forests have been cut, whether for lumber, fuel, or other uses, or simply to clear land for agricultural purposes?

No. 3. State the estimated amount of young wood growing up, and how far it will supply the place of that removed?

No. 4. State what would be the advantage in your opinion of planting trees in your county, and what trees would be best adapted?

No. 5. State what amount in acres (approximate) of the native forests has been destroyed by fire, and what means should be taken to prevent destruction of timber by fire in the future?

No. 6. State what, if any change, in character of climate, amount of rainfall, and volume of water in streams has been noted since the acreage of wood land has decreased?

No. 7. State whether there has been or is any illegal cutting of timber in your county; and if so, to what extent?

No. 8. State the proximate elevation that insures the best quality of timber, as well as dimensions; any remarkably developed tree or shrub in your locality, and the common or local name in addition to that given, and the purposes however unimportant for which they are employed?

No. 9. State what products other than wood are collected, such as tannin, charcoal, dyes, potash, edible fruits, forage, etc., and other uses in general or particular to which the forests are put?

ALPINE COUNTY.

Replies to Question No. 1.—One quarter of the forests has been cut off, for wood and lumber, and the timber left standing is black and yellow pine, and white and red fir.

No. 2.—For lumber and fuel, and mining purposes to some extent.

No. 3.—Wherever there has been a forest cut off, the young growth is starting up slowly, and it does not appear to grow very rapidly; does not exceed in growth two feet in height in a year.

No. 7.—I should judge that at least two thirds of government land had been illegally cut over.

No. 8.—Five thousand feet is the proximate elevation that insures the best lumber. Dimensions of the largest pine are from four to six feet in diameter, and from one hundred and fifty to two hundred feet in height. Firs grow fully as large.

No. 9.—None.

W. W. HARVEY, County Clerk.

EL DORADO COUNTY.

No. 1.—Fully 300,000,000 feet has been manufactured for building uses, besides immense quantities have been utilized for fuel, fence, posts, railroad ties, shakes, and mining purposes; perhaps, not over one tenth has been cut. There are many varieties of timber, the more valuable are sugar pine, yellow and punkin pine, spruce, fir, cedar, (and oak, which seems to be best adapted for fuel). I should judge that but a tenth of the forests available, have been cut.

No. 2.—The forests have been cut for uses named above, although considerable of the younger growth has been made into charcoal for local use—for such use there is an unlimited quantity. Few have the courage to hew out a farm in the thick timber, but commence on places partly cleared by sawmills.

No. 3.—The young timber springing up is far denser in growth than that removed; in fact it more than counterbalances the forests cut for all uses whatever. Some trees have already attained a diameter of two feet, and seventy or eighty feet in height, and at the present used to some extent for fuel, charcoal, and mining posts; even now some could be cut into bolts for box lumber.

No. 4.—I believe if we guard well the younger growth from the inroads of fire, and judiciously use the older growth, the supply must ever equal the demand, judging from present use.

No. 5.—Where the forests are in their primeval state, fire does but little damage, consuming mostly prostrate trunks and broken branches. On the other hand, it will, among the younger growth, completely destroy it, but fortunately such places are more thickly inhabited, and property holders find it to their interest to guard against fire as much as possible.

No. 6.—Some of the oldest settlers are of the opinion that the rainfall has increased.

No. 7.—In early days much timber was cut on government lands and left to waste, only the first cut or two being used. Since the land has been surveyed by government, mill owners and others have tried, in most cases, to obtain timber lands by lawful means.

No. 8.—From three thousand to five thousand feet; the products of the forest are the most valuable; the average diameter is, say thirty inches for milling purposes, although many trees will scale from five to eight feet in diameter, and some I have examined that had a diameter of ten feet.

No. 9.—Considerable charcoal is made for local use; none has been shipped from the county to my knowledge. Some tanbark has been used from time to time, but for local use only. A good many of the forest trees, as well as some few varieties of brush, afford considerable forage all the year round for stock. The yew tree, growing in deep cañons, has lately been utilized for archery purposes; there is a few varieties of berries, but of little value; resin and other products of wood have not been manufactured but little as yet—this is a matter of future time.

BLAIR BROS., Millmen.

Data received from J. M. Anderson, Esq., U. S. Deputy Surveyor:

Pine timber belt commences about range 12 E. in T. 10 N. The timber for ranges 12 and 13 is pine—yellow and sugar—black oak—occasionally a white oak flat—some maple along streams, and also yew along the streams; some live oak. Spruce grows luxuriantly and does not reach much above the east boundary of 13 E., and then fir grows to great perfection. The principal timber of ranges 14 and 15 E. is yellow and sugar pine, fir, and some black oak. Ranges 13, 14, and 15 are heavily timbered; here the finest sugar pine grows. Ranges 16 and 17 still more yellow and sugar pine, but these timbers do not make as fine lumber or shakes (the pine described in these ranges is not so fine as that of 13, 14, and 15), and here the larch pine makes its appearance, or what is commonly called tamarac, and the timber becomes stunted.

About one fourth of the timber belt has been cut over, but that taken has been from that most accessible, and of fine quality. There is some brush in the timber belt, but not so much as lower down—principally manzanita, shingle brush, and what is called deer or buck brush. In the mountainous regions, in swampy places, also grow quaking asp, poplar, and some little cottonwood.

All over the timber belt, and throughout the county generally, where the timber is cut off or destroyed, and the land remains undisturbed, young pines, fir, spruce, and other timber common to the country springs up almost like magic, and grow very thick, as also in parts does the different varieties of brush. The fires do most damage to these young growths of timber. Fires arise from various causes—clearing of lands, carelessness of campers, stock herders, hunters, etc. It is thought that the damage to old timber high in the mountains, from fires, is not very great. The timber in the westerly part of the county fit for milling purposes has been pretty thoroughly cleaned off, and the lands given up to agriculture and stock raising, fruit trees, and vines. In this portion of the county, where not farmed or closely grazed, young pines and other timber have sprung up, often making dense thickets.

MONTEREY COUNTY.

No. 1.—To no considerable extent have the forests been cut off. The timber in the county consists of oak, pine, and redwood. The oak and pine is used for and is good for nothing but firewood, though some of the pine has been cut for lumber. There is a considerable quantity of redwood on the coast below Monterey, and but little has been cut as yet.

No. 2.—Answered above.
No. 3.—None growing except fruit, shade, and ornamental trees.
No. 4.—Salinas Valley for a distance of seventy-five miles is ten or twelve miles wide, and the soil as good as any in the world, but in the Summer and Fall there is a strong wind which amounts almost to a hurricane at times, blowing up the valley, withering all vegetation, except where trees have been planted, and protect the crops, from which I am satisfied that three or four rows of eucalyptus trees across the valley every half mile or mile would insure good crops.
No. 5.—No very considerable amount has been destroyed. Fire is generally started by hunters and campers. Know of no means to prevent fires.
No. 7.—Not any.
No. 8.—The highest elevations in Monterey County are between 3,000 and 4,000 feet above level of the sea. Don't think there is any difference at which elevation timber grows best. The redwood tree from three to six feet in diameter. I have seen one twenty feet in diameter, and several over ten feet. It is used for lumber.
No. 9.—The acorn from the oak is used for feed for hogs. Some tanbark is being cut, of which there is considerable on the coast from Monterey City to San Luis Obispo County.

M. L. DEXTER.

NAPA COUNTY.

No. 1.—In the western half of the county a large portion of the forest timber has been cut; in the eastern half, very little. Principally pine, fir, and the several oaks indigenous to Napa County, with a limited amount of madrona, laurel, alder, ash, etc.; principally for fuel; a small portion for manufacturing.
No. 2.—A small portion for lumber; mostly in clearing land; most of it has been sold for fuel or burnt into charcoal.
No. 3.—Only a very small portion of young wood is growing up, as all of the valley land is in cultivation, and most of the available mountain lands. The present supply of timber for purposes of fuel is abundant, and will continue so for some years yet.
No. 4.—Most of the land that could be used for forest culture will soon be required for viticultural and horticultural purposes. Australian gum, the most profitable tree to cultivate, as it grows well in stony soil.
No. 5.—Loss by fire has been very small, most of it the result of careless campers and hunters in the mountains. A law that would punish by fine and imprisonment would be most effective.
No. 6.—I think no perceptible change has resulted to either climate or amount of rainfall from removing forest trees, and most of the land has been planted to fruit trees and vines, thereby increasing the amount of leaf surface.
No. 7.—There has been very little illegal cutting of timber in Napa County, and that mostly by homestead claimants, but, after cutting off the timber, have abandoned their claims.
No. 8.—I do not feel competent to answer the first division of the above question. There is no remarkably developed trees or shrubs of which I have any knowledge.
No. 9.—Only a small amount of charcoal and tanbark; the forest is used in a general way for grazing purposes.

N. L. NIELSEN, County Clerk.

PLACER COUNTY.

No. 1.—In the foothill portion, one half to two thirds has been cut off. In the higher mountains, one quarter to one half, according as the ground is smooth enough for logging and wood team. In the foothills some oak and nut pine are left standing. It is used for fuel. The underbrush, manzanita, chaparral, etc., are grubbed out when clearing land, and the best used for fuel.
No. 2.—In early days yellow pine, fit for lumber, grew as low down as Auburn, altitude 1,375 feet; now the ridge between the American and Bear Rivers is practically denuded of large trees as far as Colfax, altitude 2,441. On the two "divides" there are some ten or twelve lumber mills, Towle Brothers having the largest. In the foothills about Auburn, in clearing the land for agricultural purposes, the largest timber is made into wood; some coal; balance burned up.
No. 3.—There is considerable live oak sprouts or saplings growing where old stumps stood; also, dense groves of young pines, which grow very rapidly when trimmed up, thinned out, and kept free from fires. Some so cared for are twelve to fifteen inches through; have seen smaller trees cut in parts of the East for the mill. With care, the new growth ought to supply our future fuel; but fires, and destructive husbandmen, I fear, will unnecessarily destroy it.
No. 4.—In some of the rocky high points there should be tree planting—yellow pine, oak, walnut, etc. In the meantime the bounty for tree planting along highways should be observed. Our Supervisors refuse to pay this bounty, although several applications have been made.
No. 5.—Impossible to give approximate acreage. One fire last year burned along American River Hill one mile wide by three in length. Another over two miles near Lincoln. Damage by last, say $10,000. Perhaps an inducement by rebate of taxes for strips of land around timber tracts, carefully grubbed, plowed, and kept free from grass. A better enforcement of Section 384, Political Code, and Statutes 1871-72, page 96, or by resorting to systems of rewards for informers.

No. 6.—Old settlers say the climate is more changeable than of old—colder in Winter and hotter in Summer. The water runs off very rapidly. This Winter has given us the heaviest rainfall for years. If the young timber could be protected it would soon give a dense foliage in the mountains. The forests around Lake Bigler should be preserved.

No. 7.—In years past, yes, but at present cannot say. I have been shown gigantic sugar pine trees, five feet in diameter, felled on Government land—may be on railroad land—by shake makers, which would not split freely, and would be left to rot. It is pretty late to "lock the stable door" now. Let the Government officers answer the question if they can; I cannot.

No. 8.—2,500 to 5,000 feet seems to be the best altitude for lumber producing trees, yet very fair lumber trees grew once near Auburn. Nature seems bound to cover the hills; thirty-five years ago the Indians kept all brush burned off: now it is thick on the ground. If you strip off oak, young pines seem to grow in their place. Cut off pine, manzanita takes its place. No peculiar shrub or tree in this locality. Considerable manzanita is cut for canes and other fancy wood work.

No. 9.—We have an iron mine and furnace six miles north of Auburn. They use vast quantities of charcoal. Common nut pine they say makes the best. Much mast, or acorns for hogs, falls from the oak trees. The subject of forestry is one the United States must meet inside of twenty years. I believe if a tree could be found fit for railroad ties, a rapid grower, the waste places could be planted to a profit. I am in favor of a State law like that of Nebraska—an arbor day. Get the people in the habit of planting, and not destroying. Enforce the bounty for planting trees—nut trees if possible—along highways. Exempt forever an acre of waste land carefully set out as a forest grove. Your Board should select a small tract, say an acre, for an experimental grove. Education and demonstration for the teachable. Strict laws for the vicious and unnecessary destruction of forests. The decadence of Spain, history says, commenced when the forests were stripped of their best timber to build the invincible armada. Some of the eastern States now are on the decline for the lack of timber in the right place—in the high hills and mountains. It is only a question of time when we become a second Peru.

SAM'L J. PULLEN, County Clerk.

SAN JOAQUIN COUNTY.

No. 1.—Live oak, white oak, water oak, and willows. These have been cut off a great deal, and along the rivers there still remains a great deal of timber only fit for fuel.

No. 2.—A great deal has been cut off to clear the land for agricultural purposes, and this has been used for fuel.

No. 3.—The young trees growing up do not amount to much in this county.

No. 4.—Planting trees in this county is not very extensive. Any kind of a tree, however, will do well here.

No. 5.—None.

No. 6.—Since the wood has been cut out along the rivers, the farmers have built large levees along the banks and kept the water within these banks.

No. 7.—None.

No. 8.—The gum (blue and iron bark) makes the best growth of any tree, and produces very fine fuel. Our county is very nearly level.

No. 9.—The raising of grain and vegetables where the forests are cut.

C. W. YOLLAND, County Clerk.

SANTA CRUZ COUNTY.

No. 1.—It is estimated that full forty per cent of the native redwood has been cut off, and also the following: pine, madrona, alder, willow, and oak—the latter for its bark for tanning purposes.

No. 2.—The redwood is cut almost entirely for manufacturing purposes, such as telegraph poles, shingles, shakes, posts, for fencing and railroad ties and fuel, and for charcoal for powder. After the land is denuded from the trees cut for the above purposes, the stumps are taken out also if possible and the land is then devoted to agriculture.

No. 3.—The native redwood never dies; from the stumps four to ten feet across spring suckers, which, if cared for by thinning out and trimming, will in twenty years produce trees two to four feet in diameter.

No. 4.—In all parts of the county where considered advantageous fruit trees of all kinds are being planted, but no forest trees; fruit trees are best adapted, forest trees being in abundance.

No. 5.—Fires are frequent during the Summer months, sometimes extending over thousands of acres, but do not destroy many of the trees, they being fed by the brush and underwood; trees are badly scorched at such times, but they sprout again and appear to grow more vigorously as does the brush—only by a very careful watching and following of hunters and campers to see that they leave no fires burning.

No. 6.—There has not been any change worthy of note during the last thirty years; if any change has taken place it is not perceptible.

No. 7.—Not that has been made public in any way.

No. 8.—Throughout the mountains the various kinds of timber appear to grow more vigorously, and quality is better upon the sides of the cañons more than upon the summits, which are two hundred to one thousand feet above sea level. There is a group of native redwoods, measuring—the largest—sixty feet in circumference, known as the Big Trees, at "Big Tree" Station, on South Pacific Coast Railroad, eight miles north of Santa Cruz—employed for show only.

No. 9.—The oak known as the tanbark oak tree is servicable for its bark, which is used for tanning purposes; the bark possessing a larger percentage of tannin than any other known. Charcoal made from madrona, alder, and willow is used by the powder works here for making explosives of various kinds; the other uses are for lumber, etc., and fuel.

VITALITY OF REDWOOD TREES.

The writer of this owns a piece of land about eight hundred feet above the sea level, in the Coast Range of Santa Cruz County. About three years ago many trees were felled, sawed into lengths of about fourteen feet, then rolled down and into a cañon near by. One year after, one of the frequent fires took place, and followed up the cañon, burning all the small stuff that was inflammable, and completely charring the outside of the logs mentioned, of which there was some twenty, about three and one half to four feet in diameter. Six months ago he saw the top log of all sprouting from its sides, with numbers of green sprouts upon which the leaves had formed. The log had been cut from the tree, and much burned afterwards by the intense heat and flames drawing upwards through a small cañon, and had been lying where seen sprouting about two years and a half, and it still lived, and is yet living, not touching the earth anywhere, but resting upon other logs beneath.

S. L. WILLIAMS.

SANTA BARBARA COUNTY.

No. 1.—The live oak (Quercus agrifolia) formerly covered an area of about twenty-five square miles in the valleys of Carpenteria, Montecito, Santa Barbara, La Patera, and Dos Pueblos, on the sea side of the Santa Inez Range, but most of the trees have disappeared. Perhaps one fifth of this area is still standing in small groves and along the roadsides. The mountain ravines are yet filled with a scattered growth of these trees, together with sycamore and other species. The white oak (Quercus lobata) is scattered over the interior valleys, and is still untouched to any extent; but the rapid settlement of these lands will soon make inroads upon the trees. A body of coniferous timber at the headwaters of the Sisquoc is said to contain from nine thousand to ten thousand trees fit for lumber, on an area three quarters of a mile long and half a mile wide. This is at present inaccessible, and of course is untouched. The cottonwood and willow is found in groves along the interior streams.

No. 2.—Most of the live oaks have been cut to clear the lands of the rich alluvial valleys above mentioned for agricultural purposes, and large quantities have been taken to the City of Santa Barbara and used for fuel.

No. 3.—The mountain sides, especially of the Santa Inez Range, aré covered with chaparral, and many young live oaks are scattered through, but fires annually burn large areas of this young timber. The planting of belts of eucalyptus in the Santa Maria Valley, in its settlement, has added greatly to the forest areas; in fact, it was originally a bare plain. There are several groves and belts of this tree near Santa Barbara, Mr. Cooper having about two hundred thousand trees. The rich valleys from which the live oaks were taken are being rapidly covered with walnut and fruit orchards, fruit and nut raising being the dominant industry.

No. 4.—The valleys of the Santa Inez, Santa Maria, Sisquoc, and Los Alamos have high trade winds in the Summer, and all kinds of temperate climate fruits do well where protected from these winds. Monterey pine and cypress, the red and blue eucalyptus, and some species of acacias, all seem desirable for planting in belts. The latter is subject to insect pests, and consequently is in "bad odor." For timber and fuel the acacias and eucalyptus (some species) are the most desirable as quick growers. The black and silver wattle are rich in tannin.

No. 5.—The live oak forests have suffered but little from fires, yet the small trees on the mountain sides have been destroyed in that manner. Perhaps five thousand acres in the county would cover the loss by that cause. Stringent laws should be framed to prevent such fires. Hunters and campers should be made to feel severe penalties for carelessness. Fierce fires sweep over our mountains each year by such heedlessness. I would like to see a Commissioner appointed in each county to look after forest interests.

No. 6.—I apprehend that little climatic changes have occurred here, as the trees destroyed have been replaced by nearly the same number of trees in orchards and otherwise. I do not learn that the volume of streams has decreased. After a severe fire in the Santa Inez Mountains, at the head of Carpenteria Creek, I ventured a statement that the denudation of the watershed of that stream would increase the liability of floods, and during the following Winter a so called cloud-burst occurred, which destroyed much property and two lives, changing the course of the creek in some places. I have noticed that the winds sweep through the Carpenteria Valley with greater force, and that the frosts are more severe, since the live oak forests have been cut down. Without doubt forests modify winds and temperature.

No. 7.—From inquiries of our best surveyors and others, I cannot find that there has been much illegal cutting of timber.

No. 8.—The forest of pines, etc., before referred to, is at an elevation of four thousand feet. The largest examples of our live oak and sycamore are at an elevation little above tide water.

No. 9.—Few products have been extracted from our woods. A small amount of charcoal from the red alder has been burned for blacksmiths' purposes. The piñons from the nut pines growing on our higher mountains are used by the native Spanish population. The white oaks of the interior valleys have been cut down in excessively dry seasons for browsing fodder for the cattle, and that is one cause of the forest diminution.

F. L. KELLOGG, County Clerk.

SONOMA COUNTY.

No. 1—Cut off fifty per cent. The principal timber standing is: First, redwood, adapted to building purposes, fencing, etc.—fully one half destroyed. White oak, black oak, laurel, tanbark oak, live oak, pine, madrona, alder, etc., about one half removed in clearing farms—used for fuel chiefly.

No. 2.—The redwood was cut for lumber. Neglected clearings have grown up here and there; where cleaned off, this land proves valuable for farming and fruit growing. Other sorts of timber have been cut, and grubbed out of the way for fuel, to prepare the ground for farming; but much of it remains growing in the pastures, on the slopes, etc.

No. 3.—Patches of brush here and there, in oak clearings, amount to, say five per cent of area. Young trees and sprouts from redwood stumps are rapidly reproducing timber on ten per cent of the area cut off by sawmills. I estimate fifteen per cent a liberal allowance of young growing forest, including planted shade trees, for the timber coming in to replace the original forest in Sonoma County. The redwoods are rapidly disappearing here; three hundred millions of feet of lumber might be sawed from what is left from the Gualala on the north, to their southern limit at Freestone.

No. 7.—In former years immense quantities of timber were stolen by sawmill men and the settlers. It has ceased.

No. 8.—Redwood flourishes from the sea level to two thousand five hundred feet altitude. Tanbark and live oak the same. There is no natural limit in this county to the exclusive habitat of timber, save that the alder and willow grow along margins of streams.

No. 9.—Tanbark is an article of considerable export from this county. It is found chiefly along the coast wherever the redwood grows. Charcoal, also, is burned by parties in cleaning off the land for agricultural uses in large quantities. Orchards are planted, chiefly for home use. Little fruit is exported for lack of railroad communication. Grapes are grown enough to make two and a half million gallons wine yearly. Among other uses to which forests are put is pasturage.

J. B. ARMSTRONG.

SAN DIEGO COUNTY.

No. 1.—The timber standing is pine, cedar, white and black oak, cottonwood, sycamore, willow, and alder; can't give the percentage cut off. The pine is adapted for lumber, and the cedar and oak for fencing.

No. 2.—Part have been cut for lumber and some for fuel, and only a small amount for agricultural purposes.

No. 3.—Quite a large amount of young wood is growing in the mountains—probably from one half to one fourth the amount removed.

No. 4.—As a large portion of the county has no timber, or very little, there is no doubt that it would be very beneficial. The blue gum of Australia does well in the large valleys of the coast. The mountains are well timbered.

No. 5.—Cannot give number of acres—probably one twentieth; but fires in the mountains destroy a large amount of timber every year, and are generally started by campers' fires and Indians gathering acorns. Persons leaving fires should be punished.

No. 6.—Can't answer.

No. 7. Can't say as to present time; considerable has been cut for firewood, posts, and lumber.

No. 8.—The best sugar pine and yellow pine grows on San Jacinto Mountain, at from six thousand to seven thousand feet. Also, on the Cuyamaca Mountains, at from five thousand to six thousand feet. Dimensions, two to five feet in diameter. Three thousand to four thousand feet gives black oak; two thousand to three thousand, white scrub oak; below this come the softer woods.

No. 9.—I know of no nut-bearing trees. The Indians gather a large amount of acorns, and cattle and hogs gather the mast.

CHESTER GUNN.

VENTURA COUNTY.

No. 1.—To a very limited extent, for firewood; live oak and willow.

No. 2.—Wood and fencing, and, to a limited extent, to clear land for agricultural purposes. Quite a quantity has been cut for fuel for oil mining purposes.

No. 3.—No young wood growing except eucalyptus and pepper. Mountain fires completely destroy the fine forests, and there grow up in its place chaparral and chinquapin oak, both worthless.

No. 4.—For fencing and firewood, eucalyptus and cottonwood; advantage of change of climate, as the already limited acreage has very perceptibly increased the rainfall and fogs in the section where these forests are growing.

No. 5.—Nearly one half. Appoint an agent to look after the forests, who should reside in the immediate vicinity, and empowered with authority to stop hunters and other parties from setting out fires. A most stringent law should be enacted.

No. 6.—Since the acreage of eucalyptus and pepper has been increased in the valley, early rains have increased, and the destruction in the mountains of the pine and oak forests have lessened materially the snowfall in that region.

No. 7.—To a very limited extent. Some years ago in Township 4 N., R. 21 W., S. B. M., but I took it upon myself to warn the parties to desist, or I would complain to the proper authorities.

No. 8.—Nut pine at elevation of 2,500 feet; live oak from 300 to 2,000 feet. Three varieties of pine; the pinoul, or nut pine, sugar pine, and spruce; principally located in northeast portion of county, at an elevation of 4,000 to 6,000 feet. Not been invaded for lumber purposes.

No. 9.—None other than wood and fencing, while there is a large extent of tanbark oak in the mountains which has not been used for any purpose.

Respectfully,

DR. S. P. GUIBERSON.

THE FOREST MAP.

At a meeting of the State Board of Forestry, held at the Palace Hotel, on the nineteenth day of May, 1886, Honorable Abbot Kinney, the Chairman, addressed the Commission, stating that he had come to the conclusion that one of the most important acts to be done by the Board, should be the preparation and publication of a forest map of the entire State, showing the amount and kind of timber standing in the different counties, and its commercial uses and value. He proposed that an Engineer be appointed at once, to proceed with the work. Mr. Coleman believed that the duties of the Engineer should be enlarged; that he should be directed to collect data concerning climatic changes resulting from the denudation of timber lands, and, if possible, be clothed with power to make arrests for the illegal cutting of timber, and the setting of forest fires. It was finally decided to adopt the suggestions offered by Messrs. Kinney and Coleman, and Mr. Hubert Vischer, of San Francisco, was appointed the Engineer of the Board, with directions to enter upon his work at once. The report of the Engineer, and the forest map prepared by him, will be found in their appropriate place in this report.

ARBOR DAY.

The movement for the establishment of an Arbor Day, which has been for some time past under consideration by the Board, has lately received additional impetus through the efforts of Messrs. Joaquin Miller, Adolph Sutro, and General Howard, of the United States Army, who are working earnestly in the cause of forestry. Their plan to plant Yerba Island with trees, and to interest the school children in the movement, has done much to bring this subject prominently before the people, and has already accomplished great good. It is not necessary to refer here to the importance of establishing such a holiday, for the reason that the press for months past have been agitating this question, and seem to be unanimous in their opinion of its usefulness and necessity. The bill prepared by the Board, for presentation to the next Legislature, and the passage of which it is hoped will be one of its earliest acts, will be found elsewhere in this report.

The Board takes this occasion to return thanks to Baron Ferd. Von Mueller, of the Phytological Museum of Melbourne, Hon. Norman J. Colman of the Department of Agriculture, Washington, D. C., and Dr. F. Schomburgh of the Adelaide Botanic Gardens, for collections of forest seeds, sent from time to time, which have been forwarded to parties throughout the State interested in tree culture. The Board has sent to Australia, India, Borneo,

and other foreign countries, seeds of our native trees which were thought to be adapted to those climates.

The prevalence of forest fires during the latter part of the present year, and the immense loss to the Government and the State from these conflagrations, led the Board to the printing on canvas for distribution throughout the State of Section No. 384 of the Penal Code, which is as follows: "Every person who willfully or negligently sets on fire, or causes or procures to be set on fire, any woods, prairies, grasses, or grain on any lands in this State, is guilty of a misdemeanor, and is punishable by a fine not exceeding one thousand dollars, or imprisonment not exceeding one year, or by both such fine and imprisonment."

These canvas signs were posted quite extensively throughout the timbered districts, and although no convictions were procured, owing to the difficulties experienced and the lack of means to hunt up evidence, yet it is believed that the warning thus publicly given has had a salutary effect.

FINANCIAL REPORT.

Statement of Expenditures of State Board of Forestry from March 3, 1885, to November 1, 1886.

Appropriation		$5,000 00
Expenditures.		
Salary, Engineer H. Vischer	$752 50	
Salary, Engineer L. Wagoner	171 00	
Salary Secretary	2,112 50	
Seeds, stationery, expressage, postage, etc.	74 70	
Traveling expenses	200 00	
Maps, and photographing same	43 00	
Team, wagon, and outfit, for Engineer	517 98	
Road expenses of Engineer	362 00	
Total expenditure		$4,233 68
Balance to credit of Board		$766 32

SANDS W. FORMAN,
Secretary.

REPORT ON THE FORESTS

OF THE

Counties of Los Angeles, San Bernardino, and San Diego, California.

BY HON. ABBOT KINNEY,

Chairman of the State Board of Forestry.

FORESTS OF LOS ANGELES, SAN BERNARDINO, AND SAN DIEGO COUNTIES, CALIFORNIA.

The term forest, as it is understood in the older States, is applicable in only a limited extent to the natural tree and bush growths of California. Upon the mountain heights alone would an eastern man feel himself to be in a forest. No account of the forests of Southern California would be complete, however, without a description of all the natural tree and brush growths found here.

As has been said, there are no forests, properly speaking, in the valleys and plains. The growths in these portions of the country consist as follows:

On the plains, near the rivers, or in damp, swampy places, willows grow—often in dense, rank groves, and furnish a large amount of firewood. These are also serviceable for manufacturing the finer kinds of charcoal.

The sycamore *(Planus racemosus)* strays down the cañons and watercourses to within sound of the ocean breakers. It is only used for firewood.

In the valleys large groves of oak trees occur. These trees grow from twenty to forty feet apart and are often magnificent old monarchs, most picturesque and attractive. *Quercus lobata*, or white live oak, forms the larger part of the groves; but the red live oak (*Q. agrifolia*), with its dark, glistening, holly-like leaves, is the most attractive. This oak is extensively scattered through the cañons. The oak groves resemble the plantations of the most beautiful English parks. These magnificent trees spread a generous shade over the fields of grasses and wild flowers. Even grain is often planted under them and matures well. It is a great regret to every lover of nature to see such characteristic beauty, so difficult to recreate, rapidly disappearing.

The broader cañons, where there is enough good soil, are enchanting in their careless profusion of verdure. The red oaks, alders *(Alimo oblongifolia)*, sycamores, and maples vie with each other in supporting the grapevines *(Vitis californica)* dependent amongst them. The beautiful bay tree, or California laurel, spreads its perfume amongst many of these cañons. The mountain live oak *(Q. oblongifolia)* is found in their upper portions, and is good for timber. These growths are mixed with trees coming up from the valleys on one side, principally white oaks and elders *(Sambucus glauca)*, and down from the mountain heights on the other, principally spruce *(Abies douglasii)*. These growths are inextricably tangled up with dense chaparral and charmingly ornamented with the large fern brake.

The deciduous trees of the country are almost exclusively confined to the cañons, to the damp lands below them, or to the watercourses. A few, however, are found in the mountains.

As we leave the sea the watercourses, or more properly flood courses, of the country, are bordered by cottonwoods. The species found here are *Populus fremonti* and *P. trichocarpa*. These, like the oaks, frequently form beautiful parks on the damp lands where they grow. One of the handsomest of these groves is at San Jacinto, in San Diego County.

In places on the great Colorado Desert, and on its edges, are found several very useful stunted trees that form, in favorable spots, considerable plantations. These are the ironwood *(Olneya tesota)*, *Palo verde (Parkinsonia torreyana)*, mesquit *(Prosopis tuliflora)*, screw bean *(Prosopis pubescens)*, and several others of less importance. The mesquit and screw bean are also found scattered in the mountain valleys.

The Piñon pine grows frequently on the desert side of the mountains. These last three trees bear edible fruit, which is collected by and forms the main support of the Desert Indians. In the mountain cañons on the desert side the *Washingtonia filifera*, the striking California palm, is found. The edible oak acorns, the California walnut *(Juglans Californica)*, and the seeds of the desert trees spoken of, form important possible sources of food.

In the Mojave Desert the tree cactus grows, which has been made into paper on a large scale by an English company. This is the *Yucca brevifolia*. It grows about twenty to thirty feet high, has an extensive range on this desert, and forms the same grove like plantations so frequent in this dry country.

On the mountains the real forest is found. Considerable quantities of valuable timber exist on the Sierra Madre, San Bernardino, San Jacinto, Palomar, and Cuyamaca Mountains. The Sierra Madre Range has been too steep and inaccessible to tempt lumbermen, since the Mission days, when the southern slope was stripped of its timber. On San Bernardino and San Jacinto large sawmills are continuously at work, supplying the colonies below in the valleys with lumber, but furnishing none for export. Considerable lumber has also been cut on the Palomar and Cuyamaca Mountains. In the mountains are the sources of most of the springs and streams upon which the life of Southern California depends.

Reasonable regulations should prevent injury to these watersheds.

The principal timber cut is pine, spruce, and cedar, the latter being most valuable for posts. The most important trees in the mountains are: *Pinus lambertiana* (sugar pine); *Pinus ponderosa* (pitch pine); *Pinus Coulteri* (nut pine); *Pinus Jeffreyi* (yellow pine); *Pinus Sabiana*; *Abies*, or *Pseudotsuga Douglasii* (spruce); *Juniperus Californica* (juniper berry); *Libocedrus decurrens* (white cedar); *Abies concolor* (silver fir); *Quercus chrysolepis*; *Quercus Kelloggi*.

The timber is said by the lumbermen to be less valuable than that found further north.

The mountain forests and glades—such as Bear Valley, on San Bernardino, and Strawberry Valley, on San Jacinto—are delightful places to visit. The air is clear and bracing, and comes sweet from the pines and cedars, which with us send off a charming fragrance. The brooks are full of trout, and the thickets full of mountain quail, squirrels, and rabbits. These, with an occasional deer, give good provender to the skillful hunter.

The amount of land covered with forest is shown in the accompanying maps. Much territory, however, within the forest belt, has been burned or cut. The map does not show these forest scars, and is therefore not as accurate as we eventually hope to make it.

The low foothills near the coast are generally devoid of trees or shrubs, those on the desert are absolutely bare. With these exceptions, all the foothills and mountains not covered with trees are more or less closely thicketed with evergreen bushes, called chaparral. These grow from three to fifteen feet high, and frequently form an almost impenetrable mass. This chaparral is principally composed of scrub oaks, manzanita, wild lilac, greasewood, and sumac. On the lower foothills this brush is cut and

grubbed up by the roots for firewood. In the mountains and cañons it furnishes feed for the bees, and most important of all, it acts as a reservoir in allowing the rains of the wet season time to seep into the soil and rock veins, to appear again in the dry season as springs in the low country. This brush, together with the trees, also preserves the country from the formation of destructive torrents and floods, and modifies the desert winds, which are already at times detrimental to vegetation. These brush lands nearly all belong to the Government, the State, or the railroad, and being of little direct value will probably long remain their property. Every year disastrous fires sweep off vast areas of this mountain covering. These owners set no watch and take no heed of their property, and the fires run into and destroy the timber as well as the brush. This careless and wasteful destruction of the forests is injuring the climate, the agriculture, and the future prospects of Southern California.

The *Pinus torreyana* has been found nowhere in the world except in a little nook of San Diego County. In the second Sierra Madre Range of Los Angeles County there are a number of redwood trees *(Sequoia sempervirens)*, a fact not generally known, owing doubtless to the inaccessible character of the mountains where they are. In this connection it is proper to call attention to the considerable number of trees and shrubs perpetuated in California that have long since become extinct elsewhere. One may well think it possible that the mild and equable climate where this has happened may be as favorable to man as it has been to vegetable growths.

The necessity of the hour is an intelligent supervision of the forest and brush lands of California, with a view to their preservation in such proportion to the other lands of the State as scientific forestry may demonstrate to be necessary to the welfare of the commonwealth. My views on this subject are embodied in the report of the Board. There are many persons, however, to whom the importance of this subject is entirely unknown. For the benefit of these I have collected a number of instances of what we must expect from injudicious forest denudation. These I submit in a separate paper.

All lovers of nature and all persons familiar with the importance of forestry are anxiously hoping for prompt and intelligent action looking to the judicious management of our valuable forest property.

EXAMPLES OF FOREST DESTRUCTION.

Collected by ABBOT KINNEY, Chairman of the California State Board of Forestry.

CALIFORNIA.

The Southern Pacific Railroad was built into the City of Los Angeles through the Soledad Cañon. Until 1883, no serious damage was ever done this road by floods in that location. But about two years before this time certain parties, having stock pastured on the mountains forming the watershed of this cañon, commenced deliberately to set fires in the brush and forests on these watersheds, the idea being to improve the pastures and keep the trails open.

There are some fifty or seventy head of horses pastured through this

extensive district. These fires destroyed the water-holding capacity of the mountains. As a result, the heavy Winter rains of 1884 washed out the entire railroad, roadway, bridges, and all. Travel and business were delayed over six weeks. The railroad repaired the damages done, and the next year being very dry, no injury happened; but the year following, on an ordinary rainfall, measuring less than many of those that had previously done no damage, the railroad again sustained heavy losses.

Here is the testimony of an eye witness, as published in the Los Angeles *Herald*:

Mr. Russell Ward, of the fiber company at Ravenna, made his way to the city on horseback, leaving Ravenna on Thursday afternoon and arriving here last night, making a distance of sixty miles in a little over twenty-four hours through quicksand and flood. He rode one horse and led a second, and was often mired in the soft mud. At the fiber mill at Ravenna, the water swept through the mill, and the employés had to be carried out, the railroad switch is washed away and the station nearly gone. Above Lang's Station the $100,000 iron bridge is a complete wreck, part of it being carried upwards of twenty yards down stream. The wooden bridge is also wrecked, and the immense stone work made after the flood of two years ago was carried off like sand. The track in ten or twelve places is wrecked, for varying from twenty to one hundred and fifty yards. Below Lang's the damage is slight until the wash of the Tujungas, this side of the San Fernando tunnel, is reached, but here for miles the road is wrecked. The men from San Fernando reached Ravenna to begin operations for the repair of the track on Thursday. Mr. Ward says the floods came down the cañons in waves seven feet high, and carrying burnt trees and stones in their course. His description of the torrent's force is graphic and frightful.

Now let us take up the watershed of the Tujungas Cañons here spoken of. The watersheds of these cañons have been for some years supplying the City of Los Angeles with its firewood, and the Summer previous to these floods these mountains were devastated by fires. Mr. M. L. Wicks, a large land owner and keen business man, tells me that these fires burned over three thousand acres of land belonging to him in the Tujunga Valley, burning the brush and trees from the mountains. He describes the effects on his own lands as very serious. The rains rushed from the unprotected sides of the mountains, and cut deep and impassable gullies through many places where water had never done any damage before. No injury of a serious character happened to the railroad works at the mouth of these cañons until these causes were set in operation.

It is probably no exaggeration to say that it would have been cheap and good business for the railroad company to have paid Jock Talbot and his friend Texas $5,000,000 to have kept away from the watershed of the Soledad Cañon. The worst thing about it is, that the future promises greater floods in these localities than have ever yet happened.

In this connection it may be well to allude to the results of the small rainfall of from two to four inches in the Colorado Desert falling upon bare and perfectly arid mountains. The description of the floods on this desert by eye witnesses speak of the whole country being apparently one rushing torrent of water. Miles upon miles of railroad track are washed away at once; then, in a day or two, everything is as dry, glittering, and arid as before. These effects are spoken of as the results of cloud-bursts; but no measure of the rainfall taken at Indio or Yuma show as large a fall of water within a given time as occur in our northern, wooded, coast counties, where no such effects are known. So called waterspouts are for the most part the imagined cause of floods not really understood. It must be said, however, that other things being equal, the rainfall in a wooded country does descend more quietly and continuously than it does where there are no trees.

This may be accounted for by the different electrical conditions so clearly

explained by Mr. John Eitel, in the Sacramento papers, and also from the fact that the air above a forested country is in a comparatively homogeneous condition, while that above an arid and treeless land is in layers and currents, whereby great variations in temperature may suddenly be brought in contact, and excessive condensation of moisture take place.

The bee-men of Los Angeles County, whose apiaries have for the most part been in the same situations for many years without damage or thought of damage from floods, were washed away almost everywhere that the watersheds behind them were denuded. Here is another extract from the papers, written at the time, with an account of some of the bee-men's misfortunes, in a year of only average rainfall:

DESTRUCTION OF BEES BY FLOOD.

Great damage has been done to many apiaries in Southern California by the January floods. The greatest damage reported was done to the apiaries belonging to the estate of Ezra May, deceased, the loss being between one and two hundred hives in all. Henry Kiegel lost most of his apiary by flood in the Tujunga Cañon, and the overflow of the Picoma Creek carried away the entire apiary of Holms Maclay. Much damage was done in the Santa Monica Mountains, and the overflow of the Los Angeles and San Gabriel Rivers destroyed hundreds of hives in the low lands. Nor could any foresight have prevented the destruction of bees in these low lands, for no one could possibly foretell that the water would have reached the points it did. As the valleys and mountain sides are cleared of the natural growth of timber and shrubs, the impediments to the rapid flow of water over the land surface are removed, and we may look for greater floods than have heretofore been known, unless this rapid flow of water is checked by growing either timber or grapes on the mountain sides. Where it can be done the bee master should plant trees.

Mr. James Craig, of the Hermitage Ranch, informs me that for some years after the great Edwards fire on the watershed of the Precipice Cañon, that stream diminished in its Summer flow without regard to the rainfall, and is only now becoming itself again. This fact forced itself on Mr. Craig, as his entire water supply came from this stream. In one place this watercourse was filled up sixteen and a half feet, by actual measurement, with sand and bowlders. I am informed that the watershed of my cañon was burned over before my arrival—the traces are still plain in burnt trunks of trees—and that the Summer flow of the spring on which I depend was thereby materially diminished, while during the rains great quantities of sand and bowlders were washed from the mountain, altering the appearance of the cañon.

After my purchasee of the property from Mr. Robert Bayley, I ordered a sycamore to be cut down and the stump taken out. On going to see how the work progressed, I found the men digging out a chicken coop frame ten feet below the surface, which must have been buried by the torrent.

About six years ago I settled in the San Gabriel Valley. The road to my ranch from Los Angeles passed through what is now the town of Pasadena, then consisting of one store, a school house, and a number of orchards. The road passed on across the San Pasqual Ranch, most of which was then used to pasture sheep. At that time, between the Arroyo Seco and Precipica Cañon, there was not a single watercourse—not one place where, through pebbles or cuts, a water channel could be recognized. During my residence, until two years ago, no water ever ran across the San Pasqual Ranch between the points named. While these lands enjoyed an immunity from torrents, the foothills and mesas were covered with native growths of brush and chaparral, scrub oak, greasewood, sagebrush, etc. Every succeeding year has seen more of this covering removed from the land by clearing or fire, until now nearly all the mesas are bare of verdure.

Trees and bushes, and in fact nearly all vegetable growth, have a great

power of holding rain water and retarding its flow until it has time to sink into the earth. The leaves, twigs, and branches intercept the rain drops and diminish their force. The roots and the fallen leaves and sticks hold back the water and divide its currents. Besides this, these impediments protect the soil so that it does not cut, thus the water does not get into well defined channels where it can concentrate its force. The humus or soil of the forest and brush land has remarkable powers of absorbing moisture. It is like a sponge, in this respect, a quality of the greatest importance to perennial springs. Thus the destruction of the bushes has caused another change. The rains that were formerly absorbed on these lands are no longer taken in. Torrents have been born; orchards, vineyards, roads, fields, and fences, formerly safe, and which no one ever thought open to floods, have been damaged, partially destroyed, or altogether washed away.

Two years ago a torrent, now very plain, crossed, for the first time, the Mutual orange orchard, Mr. McCullum's orchard, and many other places, going down as far as Mr. Foord's. Last year, though the rains were so light, this torrent ran several times. I crossed it twice while water was coursing through it; but it did little additional damage. This year, however, the rains have already been heavy, causing much injury along the line named. Orange trees and hedges have been rooted up and carried off. In some places deep gullies have been cut; in others sand and gravel have been deposited—in one or two places to the extent of several feet in thickness. Another feature of this year's flood has been the continuation of the torrent's course. It went on cutting through Winston's land to the county road, where it was joined by another new watercourse. This new one came down the Villa Road to the Mission, tearing the road to pieces as it came. The two joined damaged Mr. Foord considerably. Many of his lemon trees—I should say ten or twelve—were washed quite away. His fences and gates were also injured, or carried off by the water. After leaving Foord's the water made deep gullies in the road connecting Rose and Chapman with the school house of the district, rendering the road completely impassable. The torrent ran on, devastating Mr. Titus' large pasture field, and cutting up the main road from Rose's and the St. Anita to the Mission. I know its course no further; but Mr. Leon Rose informed me that these waters seriously injured his father's lands, below this road. Another torrent on the San Pasqual came down Allen Street, cutting the lands of Mr. Hugus and others, and crossing Villa Avenue, made that avenue impassable. Another watercourse came through Mr. Craig's gate into the same road, and another came down near Mr. James Clarke's place, and crossed Villa Avenue there. All this has occurred where no damage nor even mark of damage by water had previously been known.

Further east Mr. William Allen and several smaller land owners have cleared the foothill lands extensively, and consequently several torrents have originated there that have gone on down the valley, injuring the lands of Mr. Crank, Mr. Brigden, Mr. Phillips, Mr. Samuel Chapman, Jr., and others, besides tearing the county road into holes and ditches that make it dangerous to travel. On the upper part of this district I have had for several years a ditch bringing water out of Precipica Cañon, to irrigate my lower lands with. This ditch ran along a bluff that had no cut or marks of a stream passing over it. Two years ago a cut commenced, which obliged me to bridge with a flume the chasm made. This year it has been more deeply cut by what must have been a large body of water. This has rolled out great bowlders, dropped my flume bridge, and left a great projecting talus, or large, broad, fan-shaped pile of glittering rock, where before no such thing was seen. These watercuts are new in the

country. If they have not resulted from the lessened power of the upper lands to hold water by the removal of the brush, what has caused them? It cannot be heavier rains than formerly, because last year there was a small rainfall, still that year water ran in these new torrent beds. Another consequence has been that a well near Monk's Hill, on the mesas, formerly containing thirty feet of water, became dry, and was deepened ten feet more without finding any water.

Mr. E. T. Wright, the County Surveyor, than whom no one is better able to judge, says that during the last Summer a fire had been started on the San Rafael Ranch, which burned over a mountain behind some of his land. This Winter a torrent has come down that has washed away three acres of his property, in a place where there was no torrent track before. The same facts have been observed all along the foothills and mesas of the San Gabriel Valley. Mr. P. L. Washburn, of the *Los Angeles Herald*, who owns four hundred acres in the southern end of Kern County, this side of the Tehachapi, informs me that a similar state of things is going on in that section. He travels over the country in going to his place, and he says that last Summer alone, probably owing to the large influx of settlers, fifty thousand acres of brush and forest land were burned off on the north side of the Sierra Madre Range, from the Cajon Pass west to the mountains where he is. Consequent upon this, the water is cutting gullies in numerous places burned off, or below such places, and is running during the rains in dangerous and destructive torrents. He spoke of one instance on the Cottonwood Creek, where a man had ten acres of corn land swept away by a new torrent that originated in a twice burned off mountain.

Mr. Arturo Bandini, whose family have long resided in Southern California, tells me that his relatives and their vaqueros, or herders, say that in their experience the perennial character of many streams and springs has been destroyed and the pasture injured by the extensive cutting of oak and other trees and the burning of the brush on the mountains. He gives the following special instances: He says the waters of the Arroyo Seco are now less than they formerly were. The woods and brush have been extensively cut and grubbed up by the roots for fuel or destroyed by fire. He also cites the cienega and springs near the ranch house of the "Coyote" Ranch, below Los Angeles. At this place formerly existed large springs and a sort of boggy place, or cienega. It was always the same until the monte or wood of willows around and above it was destroyed and the willows cut for fuel. Since the complete destruction of these willows the springs and cienega have disappeared, and now nothing but a white and desolate plain of alkali remains. Water and wood have disappeared together.

Mr. A. W. Canfield, of Santa Barbara, has recently sent me a valuable illustration of the effect of forest destruction which has come under his observation. Mr. Canfield is a prominent citizen of Santa Barbara, and Superintendent of the Mission Water Company of that city. This is what he says:

Three years ago a stupid fellow started a fire on the upper waters of Mission Creek, said stream being the main supply for the inhabitants of Santa Barbara City. This fire raged through a dense, heavy underbrush and forest of oak, sycamore, and pine. The enormous heat of the accumulated growth of ages burnt the ground to a cinder, and nearly all the large trees were killed to the root. After the fire we carefully surveyed our chances of reclamation, and decided to try the planting of artificial forest. Cypress and willow were set out, and seeds from the adjacent pines were planted. The heavy rains of the following Winter caused an overwhelming torrent; the soil of the burnt district gave way; landslides occurred; our dam was choked with sand and bowlders at each succeeding flood, and our planted trees and seeds were washed seaward. Since that time the scarp of the mountain stands out bold and desolate; in many places bared rocks

only appear, while the whole upper district of Mission Creek must remain bare of all vegetation. In the lower portion of the burnt district, along the cañon, chaparral has started a new life, and if unmolested further, the brush growth will soon afford grateful shade to the waning stream. This fire has naturally reduced the flow of Mission Creek. A tributary, its east fork, originally of much less volume, still unmolested by fire or axe, now contains nearly, if not quite, the same flow as the main stream.

When I first saw the watershed of Mission Creek, at Santa Barbara, it was covered with a rich mantle of verdure. This growth protected the steep mountain sides, and kept in place the soil and humus. By this means the heaviest rains were so detained as to either flow off slowly or to percolate into the deeper strata, to again appear as springs. Mr. Canfield's observations, as Superintendent of the waterworks of Santa Barbara, show that when the forest covering was destroyed three things happened. *First*—The green trees were replaced by bare, desolate rocks; thus the beauty and attractiveness of the country to strangers was diminished. *Second*—The stream took a torrential character, by landslides and washouts carrying off soil, sand, and rocks, to deposit them again on lower grades in its course. Thus every heavy rain filled up the water company's dam and reservoir with debris. *Third*—While the East Fork, with its watershed forested intact, maintained its usual flow of water, the desolated Mission Creek was so materially diminished in Summer flow as now to contain no more water than its formerly smaller tributary.

Hon. Brice Grimes, of Ventura, informs me that within the last four or five years the Santa Clara River and those of its tributaries whose sources have been stripped of timber and brush, now run more violently and destructively than formerly. As a consequence, the Santa Clara Valley is being much injured by floods. Estimates from individuals on different parts of this river show that between one thousand and five thousand acres of good land have been cut away by changes in the channel of the streams, or covered with debris, so as to be entirely worthless.

Mr. John E. Jackson, for many years County Surveyor of Los Angeles, and at present Land Valuer of the Southern Pacific Railroad Company for the southern counties, has given me the result of his observation of what has taken place here within his experience. He says that there is not a single important watershed in this section that has not been more or less devastated by fire. Equally, that there is not an important watercourse in the section that has not, within his personal knowledge, materially changed in character. Every one of our watercourses, Mr. Jackson says, is now bringing down more sand, bowlders, and debris than was formerly the case. The same rainfall now creates more rapid and destructive floods than it did before the waste of the mountain verdure. The perennial flow of the streams, with equal amounts of rain, is less than it was many years ago. He estimates that thousands upon thousands of tons of the mountain soil are being removed from the uplands and deposited in the valleys, to the disadvantage of both, especially to the water-holding property of the mountains. This effect he attributes altogether to the destruction of the forest and brush lands—principally to their destruction by fire.

INSTANCES IN OTHER PARTS OF THE UNITED STATES.

Mr. Cyrus D. Curtis, of Lamanda, Los Angeles County, informs me that when he was a boy on his father's farm, in Penobscot County, Maine, he was in the habit of catching trout in two streams running through the farm. He says he never knew the streams to fail; they were always perennial. After many years absence he returned to visit the place of his birth.

He found things very different from what he had left them. The course of both streams was wider and more irregular than before, and both ran entirely dry after the month of June. No fish were to be found in either of them. The cause of this was the complete denudation of trees on the watersheds of these streams.

Hon. Brice Grimes, of Ventura, informs me that in 1882, after twenty-nine years' absence, he returned to his father's farm in Lincoln County, Missouri. When a boy, he had been in the habit of swimming in the deeper parts of Lost Creek, and of fishing in the waters of that stream and its tributaries. On his return he found the creek dry, the water holes level beds of sand, and no fish. At the same time, the woods in which he had hunted about the sources of these streams, had been cut off and disappeared.

At my own father's farm, at Brookside, New Jersey, there was a stream called the "Mile Run." It was full of fish—had many deep holes in which we used to swim. After many years' absence I visited the old home. The woods at the source of the stream had gone, and its whole appearance had changed. The bed of the stream was much broader; large portions of the meadows and lowlands had been cut away or covered with gravel, and the stream was a mere thread of water.

Dr. Thomas Rigg, of Pasadena, informs me that Mr. Maynard, a friend of his, some years ago established a saw and gristmill in Ohio. The mill was situated on a branch of the Miami River, the course of which was through a forest. At the time the mill was built, and for years after, the stream that worked it was perennial. Eventually, however, the woods at the source of the stream were cut. The stream gradually diminished, and has now dried up. The mill property is a complete loss.

General F. A. Whittaker, of Pen Yan, New York, now residing at the Highlands Ranch, San Gabriel, writes me as follows:

> The theory that forests have a tendency to increase the fall of rain is a common and accepted one at the East, and facts seem to bear it out. There are many streams and springs, which I remember to have run with full heads, that have disappeared entirely since the woods near them have been cut.
>
> A stream flowing in Keuka Lake was formerly always full of water. Indian tradition says that they always in crossing the stream used canoes. On this stream was built a saw and gristmill and a carding machine. It is now dry a portion of the year.
>
> I bought a farm in 1857; the recommendation was *living water.* The sources of the stream have been cleared, and it is now dry most of the year. The country, as it is cleared up, has a tendency to a less fall of rain. On the Johnson farm a spring was opened, but since clearings near it is now dry.
>
> On my father's farm they are now growing wheat where there was formerly two feet of water. A spring was opened on a farm that I owned at Bluff Point. The excavation is still there, but the water is gone.

General Whittaker also speaks of a great water suit at Pen Yan, in which the evidence from the records of men who had taken the rainfall years before the existence of the Signal Service, showed that the rainfall had diminished since the clearing of the forests. Both General Whittaker and Dr. Rigg say that their observation of showers has been that these rains follow the wooded banks of streams and lakes or belts of woodland, while the cleared uplands are visited much less, and are often left quite dry.

My own experience has been the same in this regard, and I think that showers fall more copiously and more often on such wooded or watered belts than elsewhere.

Dr. A. Kimball was born and brought up near the boundary of Oneida and Lewis Counties, New York, on the edge of the Adirondack wilderness. When he was a boy the forests were intact, and the streams about his home

were filled with trout, which he enjoyed catching. Their average depth was one and a half feet. Now the woods have been destroyed, and the streams have dried up. The doctor told me this in November, 1885, at the Fruit Growers' Convention in Los Angeles.

Here is a quotation from a work that every statesman, farmer, and good citizen should read. It is from the celebrated book by George P. Marsh, "The Earth as Modified by Human Action:"

> It is an almost universal, and I believe well founded opinion, that the protection afforded by the forest against the escape of moisture from its soil by superficial flow and evaporation insures the permanence and regularity of natural springs, not only within the limits of the woods, but at some distance beyond its borders, and thus contributes to the supply of an element essential to both vegetable and animal life. As the forests are destroyed the springs which flowed from the woods, and consequently the greater watercourses fed by them, diminish both in number and volume. This fact is so familiar in the American States and the British Provinces that there are few old residents of the interior in those districts who are not able to testify to its truth as a matter of personal observation. My own recollection suggests to me many instances of this sort, and I remember one case where a small mountain spring, which disappeared after the clearing of the ground where it rose, was recovered about twenty years ago by simply allowing the bushes and young trees to grow up on a rocky knoll, not more than half an acre in extent, immediately above the spring. The ground was hardly shaded before the water reappeared, and it has ever since continued to flow without interruption. The hills in the Atlantic States formerly abounded in springs and brooks, but in many parts of these States, which were cleared a generation or two ago, the hill pastures now suffer severely from drought, and in dry seasons furnish to cattle neither grass nor water.

Cassius M. Clay, of Kentucky, has published an account of the effects of his own forest destruction. His father built a large stone mill in the blue grass region of Kentucky. The stream on which it stood was perennial, and the mill ground the wheat grown upon the farm. When Mr. Clay, Jr., came into his estate he girdled and killed all the trees on the hills, with a view to increasing his pasture range. The effects were very different from what he had anticipated. The stream dried up and the mill became useless. It also became useless from another cause, and that was the failure of the wheat crop. Mr. Clay says that the climate of his part of Kentucky has materially changed, owing to the extensive destruction of forests. Late frost, drought, and wind have become very injurious to vegetation. The returns in agriculture have become more uncertain than formerly, and some crops fail altogether. Amongst other crops, wheat on his farm gave no longer a remunerative yield. The old mill was pulled down and the stone used for other purposes. Mr. Clay gives the facts in detail, and publishes them as a warning to others.

George Allison, of Canada, says: "I am satisfied that the sudden climatic changes, now so much more injurious to Canadian agriculture than formerly, are largely due to the destruction of our forests."

The diminished flow of the Hudson River, and of the feeders of the Erie Canal in New York, has alarmed the people of the State. This effect is attributed to the destruction of the forests at the sources of the streams. The State has taken action in the matter, with a view to prevent further forest destruction, and has reserved its own large amount of forest lands from sale.

Mr. Sherman Washburn informs me that on his father's farm in Steuben County, New York, there was a stream that ran a mill situated on it. The forest was gradually cleared at its source and now the stream is no longer perennial, but only flows in heavy rains, for a short time, having lost its character and value.

Hon. H. H. Markham, present member of Congress from this district, in answer to a letter of mine, gives me the following information:

I was born, reared, and have always lived in a timber country, and have watched the effect of timber upon natural watercourses, and I am therefore fortified in my belief that your position is correct. My brother owns a farm in Sheboygan County, Wisconsin, a county heavily timbered. He built a shingle mill on the creek passing through his farm, and ran it by water power, but as the land surrounding him became shorn of its timber and cultivated, the stream diminished and soon became dry. He sold, and purchased another tract in the next county north, and when I first saw it in 1861, there was a stream running through it containing sufficient water to allow him and others to float double-length railroad ties by the hundreds down to market. The surrounding country was rapidly cleared, and within six years the stream became dry, with no water except in rainy seasons.

FOREIGN INSTANCES.

The agricultural editor of the *Adelaide Observer*, in South Australia, speaks as follows of the effects of forest denudation in that country:

We all know that the River Torrens was a deep chain of connected waterholes all along its course, and that it was necessary to have a boat for crossing it in the early days. I have been ferried across the Torrens by Mr. Moorhouse's boys several times as a youngster; but the bed of the river soon filled up, the waterfall that existed at the back of the gaol disappeared, and before the dam was erected it was easy to cross almost dry-footed anywhere; whilst the bed of the river below the slaughterhouse, until late years, was quite dry. The North and the South Paras are also very dry during Summer time, and I have no doubt many other petty rivulets are equally altered in character. Now, each of these streams was thickly shaded with fine large red gums in the early days, and the banks were completely embowered with tall and handsome flowering shrubs. At that time we were used to see a heavy dew upon the ground nearly every morning throughout the Summer. Then the climate was milder than now, and fruits of all kinds ripened a month at least sooner. We were used to very frequent thunderstorms in Summer, which resulted in rains at that period of the year which we do not now experience. As the trees were destroyed by fire and ax the streams filled up and diminished in volume, the thunderstorms in Summer ceased, the Summer dews disappeared, and the ripening season for our fruits became later and later. At first we could get sweet and ripe watermelons at Christmas or New Year's Day; now we generally get them about March, when there are a few ripe and ready for use.

The Volga River in Russia presents a striking example of the effect of destroying forests. Its movement has become an alternation of destructive floods and droughts which render its navigation difficult and uncertain. It is the longest river in Europe and empties into the Caspian Sea. It is about one mile wide in its center part, and two or three miles near and at its mouth. Canal systems connect it with the Neva, St. Petersburg, and the Baltic, and immense as this waterway system is, it is proposed to extend it to Archangel, and the White Sea, and also to the River Don. The incalculable usefulness of this system of navigation has only one serious drawback—the stream of the Volga becomes narrower every year in the dry season, and the floods shift channels and pile up great sand banks. * * * The only remedy for the floods and droughts is to arrest the destruction of the forests, and it is said the Russian Government will attempt to do so. Unfortunately the remedy will not act as swiftly as the evil which in a few years has greatly increased the difficulties of navigation.

Mr. Gervoise Purcell, B.A.C.E., formerly in the employ of the Japanese Government as engineer, has written me a letter containing observations of his while in Japan.

The destruction of forests in that country, consequent on the repeal of the old forestry laws, has produced very serious results. Mr. Purcell's facts from Japan show not only the cutting of torrents into the soil, but the deposit of that soil in the valleys as the slickens have been deposited in the Sacramento Valley when the grade of the stream decreases. As soon as a stream emerges from its steep mountain course to the level valley it must run slower, and at once commences to drop its load of debris. From such deposits many rivers in Japan have so raised their beds, which the inhabitants for self protection have as constantly levied, that when railroads were built it became necessary to *tunnel* under the rivers instead of bridging over them. Here is some of the evidence of Mr. Purcell:

The Kusatsagawa in the province of Oerie, emptying into Lake Biaa, is twelve feet above surrounding country at the Uakaendo crossing, and lower down where it is bifurcated, the branches are thirty feet above the plane. The Ashijagawa crosses the Kabe

Osaka Railway. Lowest point of river bed twenty-two feet above surrounding plane, and to top of levees is thirty-two feet. *The railway passes underneath the river through a brick tunnel.* There are several other rivers under which the same railway passes, but this is a type of them all.

The Kamaisbigawa, over which I built twenty-four bridges, had a flood width of one hundred and ninety-five feet, but owing to the denudation of the timber on the watershed to make charcoal for the smelting works, and to lay bare the iron ore deposits at its source, in the year 1877, after a three days tornado, the flood width was increased to three hundred and ninety-five feet, and high water mark raised six feet. Immense rifts were made in the denuded hillsides, in many instances fifty feet deep at the base. I may add I traced the high water mark of the Kamaisbigawa back one hundred and thirty years. The cutting of timber for smelting purposes commenced in 1873.

I have a large amount of cumulative testimony on these questions, but, as these cited are enough to cover the ground, it will only drag out the report into too great length without doing good to cite more of them. I shall therefore conclude these instances with one direct piece of evidence of what overpasturing in forests and mountains, and the consequent killing of the young growth, so that as the forest dies out or is destroyed it is not renewed, does to the country and to these pastures themselves. It is a case of killing the goose that laid the golden egg.

Arthur Young, one of the most attentive observers who has left memoirs of his travels, wrote, in 1789, a description of the country about Barcelonette, in France. He says, as cited by Marsh: "The hill pastures feed a million of sheep, besides large herds of other cattle;" and he adds, "with such a soil and in such a climate we are not to suppose a country barren because it is mountainous. The valleys I have visited are generally beautiful." In 1806 Hericart de Thury said of the Valley of Embrun, in France: "In this magnificent valley nature has been prodigal of her gifts. Its inhabitants have blindly reveled in her favors and fallen asleep in the midst of her profusion."

Now let us see what has happened to these beautiful countries after the trees and undergrowth on the mountains were destroyed. Blanqui, a celebrated French political economist, in a memoir published in 1843, says:

The clear, brilliant, Alpine sky of Embrun, of Gap, of Barcelonette, and of Digue, which for months is without a cloud, produces droughts interrupted only by diluvial rains, like those of the tropics.

The abuse of the right of pasturage and the felling of the woods have stripped the soil of all its grass and all its trees, and the scorching sun bakes it to the consistence of porphyry. When moistened by the rain, as it has neither support or cohesion, it rolls down to the valleys sometimes in floods resembling black, yellow, or reddish mud, sometimes in streams of pebbles and even huge blocks of stone, which pour down with a frightful roar, and in their swift course exhibit the most convulsive movements. * * * The elements of destruction are increasing in violence. The devastation advances in geometrical progression as the higher slopes are bared of their wood; and the ruin from above, to use the words of a peasant, helps to hasten the desolation below.

The Alps of Provence present a terrible aspect. In the more equable climate of northern France, one can form no conception of those parched mountain gorges, where not even a bush can be found to shelter a bird; where, at most, the wanderer sees in Summer here and there a withered lavender; where all the springs are dried up, and where a dead silence, hardly broken by the hum of an insect, prevails; but if a storm breaks forth, masses of water suddenly shoot from the mountain heights into the shattered gulfs, waste without irrigating, deluge without refreshing the soil they overflow in their swift descent, and leave it even more seared than it was from want of moisture. Man at last retires from the fearful desert; and I have the present season found not a living soul in districts where I remember to have enjoyed hospitality thirty years ago.

Thus we have the evidence of accurate observers as to the beauty and productiveness of this part of France; and we have also the testimony of scientific men as to the desolation that now reigns in these districts which has followed the destruction of the forests and undergrowth. Marsh shows that the denudation of the mountains in Provence did not commence until the close of the fifteenth century. At that time Provence was the wealth-

iest and most celebrated par of France. In the sixteenth century the destruction of forests was great. In the seventeenth, we see the statistics changing. Marsh says:

There was an alarming decrease both in the wealth and in the population of Upper Provence and Dauphiny, although by the clearing of the forests a greater area of plow land and pasturage had been added to the soil before reduced to cultivation. It was found, in fact, that the augmented violence of the torrents had swept away, or buried in sand and gravel, more land than had been reclaimed by clearing; and the *taxes* computed by fires or habitations, underwent several successive *reductions* in consequence of the gradual abondonment of the wasted soil by its starving occupants. * * * * * * *

The physical decay of the uplands was such that considerable tracts were deserted altogether, and in Upper Provence the fires (or habitations), which in 1471 counted eight hundred and ninety-seven, were reduced to seven hundred and forty-seven in 1699, to seven hundred and twenty-eight in 1733, and to six hundred and thirty-five in 1776; and this while those parts of France not subject to torrents were rapidly increasing in wealth and population. Provence, in climate and soil, is very like Southern California. Causes in active operation here have injured the whole of that once fertile and beautiful country, and altogether ruined much of it. These causes ought to be suppressed and stopped.

The people of France have long since recognized the value of forests as holders and distributers of moisture, as well as for other purposes, and they have a well regulated system of forest preservation, whereby the products of the forest are used and bring in a vast revenue, of from two to three dollars per acre a year. And still, the cutting is so regulated as to insure a new growth, and prevent the birth of torrents. A sensible and progressive people like we Americans, should certainly not wait for ruin and desolation to force us to enormously expensive reforestation, which would still leave the productive lands once destroyed forever desert.

Kinneloa Ranch, Los Angeles County, California.

REPORT ON THE FORESTS

OF THE

Counties of Amador, Calaveras, Tuolumne, and Mariposa, California.

BY LUTHER WAGONER, M.E.

FORESTS OF AMADOR, CALAVERAS, TUOLUMNE, AND MARIPOSA COUNTIES, CALIFORNIA.

San Francisco, Cal., August 9, 1886.

Hon. Abbot Kinney, *Chairman State Board of Forestry:*

Sir: I have completed the examination of the condition of the forests in Amador, Calaveras, Tuolumne, and Mariposa Counties, and submit the following report. My examination has, in general, been confined to the central and lower parts of the above named counties, excepting a special trip to the summit of the Sierras, via Sonora and Mono Road; the remainder of the information was procured from the citizens and officials of the various counties.

THE SOIL.

Beginning at the foothills, the rocks are principally slates, with occasional bands of granite and serpentine. This belt is thirty to forty miles in width, and at its eastern limit, three thousand to four thousand feet above the sea level. Eastward, and to the summit, the country rock is granite, and in many places capped by volcanic rocks. Where the latter has decomposed and blended with the granite and slates, the soil is stronger, and the trees are larger and more numerous than where a purely granite soil exists; this is very apparent in the high Sierras, the trees growing in the valleys not being as large and perfect as those at the same level, but having a mixed soil. The most perfect specimens of trees are found, as a rule, near the foot of a hill, or on gentle slopes, where the soil is easily retained and always renewed by the wash from above.

COMPOSITION OF THE FORESTS.

The following table will give an idea of the percentage and distribution of the principal trees, the lower limits being averages, and the upper limits are those observed on the Sonora and Mono Road. The table refers to the original state of the forest before any cutting was done.

The belt covered by any species might be very nearly represented by contour lines nearly level, the lines being isotherms, or perhaps more accurately, by contour lines having certain fixed means of heat and moisture for the upper and lower limits. There are some exceptions to this for lower limits, as on streams; thus tamarack is usually found above six thousand feet elevation, but one case is reported of finding a few trees on the south fork of the Stanislaus, at about four thousand feet elevation.

Name of Principal Trees.	Height Above Sea Level, in Feet.		Average Width of the Zone, in Miles	Estimated Percentage of Trees	Remarks.
	Lowest.	Highest.			
Digger Pine (*P. Sab.*)	430	2,900	25	9	
Yellow Pine (*P. Pond.*)	1,700	8,280	50	31	Includes the black pines.
Sugar Pine (*P. Lambert*)	2,100	6,277	38	5	
Red Fir (*A. Mag.*)	3,000	8,660	45	24	Includes the white barked fir.
Cedar (*Lib. Oc.*)	2,000	7,830	48	15	
Tamarack (*P. Mur.*)	6,000	10,300	20	6	
Juniper (*Jun. Oc.*)	6,000	10,400	12	1	Juniper 10 feet diameter at 8,500 feet elevation, near Baker's Station.
Big Trees (*Seq. Gigan.*)	4,700	4,700			
White Oak (*Q. Lob.*)		3,000	20	5	White barked oak of San Joaquin Valley.
Black Oak (*Q. Kell.*)	500	8,000?	50	4	Small shrubby oak at 8,000 feet.
Chinquapin (*East Chrys.*)		6,800			Observed as a bush or shrub at 6,800 feet.
Dogwood (*Cor. Nutt.*)	4,000	7,000			Not common.
Cottonwood (leaf o 1½ in., 0 2½ in.), two species	6,000	9,000			Near streams.
				100	

In addition to the forest trees, mention should be made of the chaparral, chemisal, and manzanita, that cover nearly all the open country between five hundred and three thousand feet elevation, the latter reaching an altitude of over eight thousand feet, and there being a low shrub.*

PRESENT CONDITION.

The present line of timber fit for sawing is now twelve to fifteen miles east of its original location, and perhaps has an average elevation of three thousand eight hundred to four thousand feet, as against one thousand seven hundred to two thousand one hundred feet originally. Where this area has not been cultivated the growth of new trees has been rapid, digger pine and oak being the principal trees, with some yellow pine.

EFFECT UPON STREAMS.

The oldest settlers best qualified to speak upon this matter, declare that the volume of water in the lower streams, as main rivers (Mokelumne, Stanislaus, Tuolumne, etc.), has not diminished from what it was in the early years of mining, 1849–55, while other people who are good judges think that originally there was more water, and that it was absorbed by the fringe of trees that lined the streams before they were mined, and that the effect of the destruction of the trees was to diminish the volume of water, but as little of it was absorbed by vegetation near the banks, the lower streams still have something near their original volume. Near Sheep Ranch, Calaveras County, is an example confirming this view, where originally a small stream was thickly lined with trees, and then no water ran in the Summer from the lower stream. After the trees were all cut away the stream flows all the year. Of course in the absence of long and careful observation, but little weight can be attached to these opinions.

* Also the alder that grows on the banks of streams, six hundred to seven thousand feet.

SURFACE EROSION.

I was instructed by Mr. Vischer to examine the question of surface erosion caused by cutting away the timber covering, but have been unable to find any one who had noticed the matter, the general answer being that a growth of underbrush soon followed, and served to protect the soil nearly as well as the trees did, so that unless it had been a special subject of investigation it would not be noticed.

LOSSES BY FOREST FIRES.

There is perhaps no part of the forest but which has been ravaged by fires. The burned trees in remote parts show that at some time fire has passed over the woods. As to their origin, no definite information can be had in the lower and central zones, but I think it can be safely affirmed that at an elevation of three thousand five hundred to five thousand feet (the region of the sawmill post and shake business) the people are reasonably careful to prevent fires, because it would be injurious to them, as the woods always contain logs, wood, shakes, and posts that would be destroyed in any extensive fire above this elevation. The stock men (cattle and sheep) are charged with deliberately firing the forest so as to clear underbrush and afford a crop of grass for the ensuing year. More of this burning is done on the high Sierras than elsewhere. I have found it very difficult to get exact information from the citizens about this matter, and further than the general statement given above they do not like to go.

In my opinion the only possible way to stop the burning will be to have a special agent to enforce the law against offenders, as public opinion is too apathetic at present to regard it as a serious matter. The damage done by shake makers has been so often mentioned that it will only receive a notice. The greater portion of the timber is stolen directly from the public lands, and the matter could perhaps be reached in this way, if desirable.

SHEEP FARMING.

The high Sierra is composed of rocky soil, generally quite thin and easily dislodged. The sheep make numerous nearly horizontal trails, and dislodge the soil and humus, and kill young trees by trampling and dislodging soil. I think there is no doubt that the damage done by sheep is greater than their value, and if they could be shut out entirely the State would be the gainer by doing so.

TREE PLANTING.

But little has been done in the way of planting foreign trees. The older towns, notably Jackson, Mokelumne Hill, San Andreas, Murphy's, and Sonora, have their streets lined with black locust (*Rob. P. Ac.*), all in a very vigorous healthy condition. Some of these trees are over thirty years old. English walnut, also, is grown in these towns, and is large and vigorous. There are several cork oaks growing at the Patterson Mine, Tuttletown, Tuolumne County (elevation, one thousand four hundred feet). The largest are twenty-eight years old, and measure about seventeen inches diameter. The seed was brought from Europe by Mr. H. Orlandi.

The orange is growing in Sonora at an elevation of two thousand feet, and bears well. Apples are at their best at two thousand five hundred to

three thousand one hundred feet elevation. Practical measures should be taken to plant trees having an economic value, such as hickory, ash, and black walnut. The forests of this State being notably deficient in the valuable hard woods, their cultivation would be of great utility.

Annexed to this report is a map of the four counties upon which I have traced the present line of timber fit for sawing into lumber. This line has moved eastwardly about fifteen miles, or half a mile per year, but at present the rate of cutting is not so great, for two reasons: The present line is near the heart of the original forest, and it yields more per acre; also, the demand is not so great as in former times.

There is also accompanying this report a set of photographs, taken August third, on the Sonora and Mono Road, to illustrate the different trees and their distribution in the high Sierras.

Very respectfully,

LUTHER WAGONER, M.E.

REPORT

ON THE

Trees and Shrubs of San Diego County, California.

BY C. R. ORCUTT.

TREES AND SHRUBS OF SAN DIEGO COUNTY, CALIFORNIA.

The northern part of San Diego County seems to form the southern limit of many of the trees and shrubs of the State, while on the other hand the southern part possesses a considerable number from the southern, or Mexican, flora. The county may be otherwise divided into the (1) coast region, where only a few shrubs and bushes may be found, with the single exception of the Soledad pine; (2) the lower foothills, including the larger valleys near the coast and the numerous cañons; (3) the higher foothills and the mountains below four thousand feet in altitude; (4) the mountains above four thousand feet: and (5) the desert region. As it will be of interest to know the limit of the distribution of our trees and shrubs, I add notes on those found extending southward into the Californian peninsula. I will now note the ligneous plants in their natural order.

Berberis Fremonti, Ton., is found near the desert in the southern part of the county, and in the mountains of Lower California. *B. Pinnata*, Lag., is found among the foothills but not abundant. These barberries are of no value.

The poppy family gives us the *Dendromecon rigidum* throughout the foothills southward, and the *Romneya coulteri*, which is found abundant as far south as San Vicente Mission, growing in the valleys and on the sides of the mountains.

Isomeris arborea is a small shrub found near the bay and southward.

Fouquiera splendens extends into the county along the desert borders from the south.

Malvastrum Thurberi, abundant on the mesas near the city, extending farther inland.

Fremontia Californica extends from the north into the peninsula near the boundary. This forms a small tree, and bears beautiful abutilon-like flowers.

Larrea Mexicana is a desert shrub.

Cueoridium dumosum extends from the coast into the foothills, southward into the peninsula.

Euonymus occidentalis finds its southern limit in the Cuyamaca Mountain.

Zizyphus Parryi, *Z. lycioides*, var. canesceus, and *Condalia spathulata*, are small desert shrubs. *Rhamnus crocea* extends into the foothills and southward; *R. Californica* and a variety taking its place in the mountains.

Adolphia Californica is a small bush, abundant near the city, that becomes a fair sized shrub further south in the peninsula.

Of the wild lilacs, *ceanothus*, *sorediatus*, *divaricatus*, and *cuneatus* are abundant near the coast back into the foothills, and even extending into the mountains, where *ceanothus integenimus* is also found. *C. rigidus* is found in the northern part of the county. The first named species extend into the peninsula as far as San Vicente.

Vitis Californica grows in some of the cañons back from the coast, but has not been observed southward.

No buckeye is known in the county, but *Æsculus Panyi* is found along the coast from north of Todos Santos Bay to Rosario, in Lower California, and forms a low shrub, the trunk with a dimaeter of a few inches to a foot or more.

Acer macrophyllum is found in the mountains in the northern part.

The sumacs are abundant, and all extend southward into Baja California. *Rhus laurina* is common near the coast in little cañons and among the foothills, where it forms large clumps, twenty feet or more in height. *R. integrifolia* forms a low shrub nearly a foot or two high on the ocean beach, but in the sheltered cañons near by it becomes a small sized tree. On Todos Santos Bay, Lower California, I have seen the trunk nearly two feet in diameter, and fifteen to twenty feet high. *R. ovata* takes its place in the higher foothills. This species produces a sugar which is collected by Indians sometimes. The fruit, like the preceding and other species, is red, a pleasant tart, and when put in water makes a cooling drink. The fruit is also credited with medicinal qualities.

The poison oak, *rhus diversiloba*, is also abundant throughout the county and southward usually near watercourses.

Rhus armatica, var. *trilobata*, and var. *indivisa*, are found among the hills and mountains, the latter extending into Lower California. They are merely small bushes.

A large shrubby lupine, *Lupinus albicaulis* or *L. douglasii* (perhaps both species), is found among the hills; abundant south.

Proralea macrostachya and *Amorpha Californica*, are tall, slender shrubs, belonging to the leguminosæ, common near water among the foothills, and extending southward; the latter also growing in the mountains.

One or more shrubby daleas are found on the desert and in the cañons leading to the desert, where are also found various other small trees like the iron wood, *Olneya tesota*, *Parkinsonia torreyana*, *Palo veide*, *Prosopis juliflora*, *Mesquit*, *Prosopis pubescens*, screw bean, and *Acacia greggii*. The three latter species are found west of the Sierras also, and extend southward among the foothills, often forming the only trees in many of the larger desert valleys.

Primus ilicifolia, oak-leaf cherry, grows throughout the county, southward. *P. demissa*, our choke cherry, is found in the high mountains of the northern part. *P. fremonti* and *P. fasciculata* are desert shrubs, the former abundant near the coast, also south of Todos Santos Bay, Lower California.

Chamæbatia foliolosa, the tar bush, is found on some of the mountains and hills near the coast and southward. *Purshia tridentata* is a small desert brush.

Cercocarpus parvifolius, the feather tree, grows twenty feet high or more in favorable locations, and is abundant throughout the county, and southward among the foothills.

Adenostoma fasciculatum, or greasewood, forms a considerable part of the firewood brought into town by Mexicans, and covers large areas of mesas and hills throughout the county from Port Lama into the mountains, and southward as far as San Telmo. *A. sparsifolium* largely takes its place among the lower mountains, and is generally called deer brush. From two to ten feet is the usual height of both species.

Rosa Californica and *Heteromeles arbutifolia* extend throughout the county into Lower California.

Several species of *ribes* grow in the county, but are of no value.

Cornus Californica is found as far south as Cuyamaca Mountain. *Gauya flavescens*, var. *Palmeri*, is a small shrub found among the mountains

along our southern frontier, extending into the higher mountains of the peninsula.

Sambucus glauca, elder, grows in abundance, sometimes attaining considerable size.

The composite shrubs are various species of *baccharis*, *pluchea*, *borealis*, *hymenoclea salsola*, and *moagyra*, several *artemisias*, and a *tetradymia*, which constitute a large part of the brush along our watercourses and on our hills.

Six kinds of manzanitas are also known with us. *Arctostaphylos bicolor*, growing near the coast, *A. oppositifolia* and *A. diversifolia*, straying near the border from Mexico, and *A. pungens*, *glauca*, and *tomentosa*, which extend from the north through the mountains into Lower California.

Rhododendrar occidentale is found in Cuyamaca Mountain—doubtless its southern limit.

Fraxinus Oregana—Oregon ash; possibly strays into the county on the north, and *F. dipstala*, the beautiful flowering ash, which forms a small tree, strays in from the south. Two kinds of yerba santa,, credited with great medicinal properties, are found in the county—*Eriodictaon tomentosum*, near the coast, and *E. glutinosum*, among the hills and mountains. A third and more valuable species is found around Todos Santos Bay, where it takes the place of *E. tomentosum*.

The tobacco tree, *nicotiana glauca*, though not a native, is fairly naturalized near the city. Several species of *lycium* grow in the county, some ten feet high or more.

Miumlus glutinosis and *M. puniceus* are small bushes bearing beautiful and showy flowers in the Spring. The latter grows near the coast.

Chilopsis saligna, the desert willow, is found on the desert border, at Jacumba.

The white sage, *Andibertia polystachya*, is scarcely more than brush, but grows six to ten feet high, and forms an important plant, making excellent bee pastures. *Andibertia stachyoides*, *A. trichostema*, *Eriogonum fasciculatum*, *Atriplex canesceus*, *Eurotia lanata*, of the desert, etc., are other kinds of brush that can scarcely be called shrubs.

The laurel, *Umbellularia Californica*, extends into the county from the north, and is said to be found on Cuyamaca Mountain.

Sycamores, *Planus racemosus* are found along the watercourses, among the hills, as far south as San Quentin Bay, Lower California.

Simmondia Californica, common around San Diego and in the cañons, often forms a small graceful tree south of the line. Along San Diego Bay it grows scarcely two feet high. It bears an oily nut that is not unpleasant eating. *Euphorbia misera* is a small shrub, extending from Point Loma southward among the hills, near the coast, to Rosario, Lower California. *Acalypha Californica* very rarely becomes a small shrub.

Alnus oblongifolia is found near the headwaters of the San Diego River, in the Jamacha Valley, and on the mountains, growing to a height of forty feet or more, and a foot in diameter.

Willows are found along the watercourses throughout the county, *Salix lasivlepis* probably being the commonest species. Cottonwood are abundant in some of the inland valleys, *Populus fremonte* var. *wislizeni* being the species common in the south. *P. trichocarpa* strays into the county in the north, as also *Juglaus Californica*—the wild Californian walnut, and *Castanopsis chrysaphilla*.

Quercus dianosa—a worthless shrub oak—is common throughout the county, and southward another shrub oak, *Q. pungens*, strays into the

county from Arizona, and is found near camps on the southern boundary with *Q. Dunnii*—the holly-leaved shrub oak which is better known as *Q. Palmeri*. The Californian live oak, *Q. agrifolia*, grows abundantly among the hills, reaching an elevation of five thousand feet, and is found southward in the peninsula to near the Sta. Tomas Mission. This furnishes a large part of the oak wood that is used in San Diego. *Q. oblongifolia*, known as the post, or white oak, is found among the valleys and higher foothills. *Q. Emoryi*, a small tree, extends into the mountains of Lower California south of the line, and may be found in the county. *Quercus Kelloggi* and *Q. crysolepis* are found in abundance on Cuyamaca Mountain northward, and I have seen a few stunted trees of the latter near Hanson's Ranch in Lower California.

Juniperus Californicus is not rare on the mountains, and extends northward into the peninsula to near the coast among the foothills. Two kinds of cypress grow near the city among the hills, one probably *Cupressus macrocarpa*, and the other a stunted form of the beautiful Guadaloupe Island cypress, *Cupressus guadaloupensis*, which extends south into the peninsula.

The only survivers of *Pinus tonrryana*, a small tree belonging to a past age, are found along the ocean bluff at Soledad twenty miles north of San Diego. Near Elsinore a few pines are found that seem to belong to *Pinus tuberculata*. On the mountains east, at an altitude of six or seven thousand feet, are found the sugar pine—*Pinus lambertiana*, *Pinus coulteri*, *Pinus pondersoa*, *Pinus sabiniana*, and the *Pseudotsuga douglasii*, var. *Macroscarpa*. At Pine Valley and elsewhere, are found the large yellow or bull pine, *Pinus jeffreyi*, which extends south into the Lower California mountains, where they form large forests at Hanson's ranch. Coulter's pine also extends into Lower California, but seems exceedingly rare. On the table lands overlooking the desert are found the two piñon or nut pines, *Pinus monophylla* and *Pinus parryana*, which are found sound in the broad table lands of Lower California to an altitude of six thousand feet, where *Pinus parryana* predominates over the more northern species, which seems to be restricted to a narrow belt next to the desert.

Mr. Robert C. E. Stearns, Ph.D., of Berkeley, publishes in the *American Journal of Forestry*, as quoted by Dr. Chipman, the following statement as to the profits of planting the *Eucalyptus globulus*: "General Stratton planted forty-five acres in eucalyptus in 1869. Recently twenty acres of this artificial forest have been cleared to make room for an orchard, and after charging every item of cost and a yearly rental of five dollars per acre, the net profits, as shown by the owner, are \$3,866 on the twenty acres in eleven years." Dr. M. M. Chipman also cites in an article on the Importance to Health of Forests, published in the transactions of the Medical Society of the State of California, the statement of Mr. George A. Nadeau as to the value of a eucalyptus grove under his control, seven miles south of Los Angeles. Cost of trees at the time of setting out \$7 50 per acre; labor of replanting, \$5 per acre; after cultivation, \$5 per acre; rental of land at \$3 per acre per annum, amounts to \$21 per acre for the seven years; total cost per acre for the seven years growth, \$38 50. The estimated average amount of the wood on the land is thirty-five cords per acre, which is worth in that locality \$3 per cord in the tree, giving \$105 per acre as the present value of the timber; or the total cost of the body of timber, \$3,734 50, and the present value, \$10,185; net profit, \$6,450 50." These eucalyptus grow readily and rapidly from the stump, and produce with little care and in a short time, another merchantable crop. It must be borne in mind, however,

that the *E. globulus* only does well in at least a moderately moist situation, as has been before stated in this report.

Last, but not least, are the beautiful California palms so highly prized by horticulturists. The fan palm, *Washingtonia filifera*, is found abundant in the cañons leading to the Colorado Desert, where also are found a few of the blue palms, *Erythea armata*. Other varieties or species may exist, as these magnificent trees are little known, and new discoveries likely to be made when our desert borders are more fully explored. These palms are found in Lower California in the desert cañons, and also west of the mountains, the Washingtonia appearing in a few cañons at Valle de Los Palmas, Lower California (about fifty miles from San Diego), and the blue palm growing near San Quentin Bay.

In this hasty outline of our native trees and shrubs, and of their distribution, it seems desirable to add that nearly all of the shrubs mentioned in the preceding, disappear one by one as we proceed southward along the coast road in Lower California, and other plants—mainly cactus—take their places. The more common shrubs continue as far south as San Quentin Bay, where the last of the trees, and many of the shrubs, will be left behind, and there the botanist will enter upon the dividing belt between the tropical and the temperate floras.

C. R. ORCUTT.

FOREST TREES FOR PROFIT.

By MILTON THOMAS, Esq., Los Angeles, California.

FOREST TREES FOR PROFIT.

To Abbot Kinney, *Commissioner of Forestry:*

I have been requested by you to prepare a paper on the planting of forest trees for profit. I will say that I have had some experience in that line, having planted forty acres of blue gum; also, some red gum, catalpa, and black walnut; and I intend to plant out sixty acres more this coming Winter, and will plant the red variety, and some black walnut. I prefer the red gum *(Eucalyptus rostrata)* to the blue, from the fact that the red splits readily, and is much easier worked up into wood. The blue gum is hard to split, and costs much more to put into marketable shape. The red gum endures the frost well. Frosts that would injure the blue gum, and in some instances kill them, do not injure the red at all. The red gum does not grow quite as rapidly as the blue, but upon the whole, I certainly would advise people that want to raise a forest of timber for profit, to plant the red gum. Some plant these trees eight by eight feet, others six by ten feet. I planted ten by ten feet, believing that when they are six years old or older, I would have more timber to the acre than those who planted them nearer together. I have noticed that trees planted at a reasonable distance are always larger than those very near together. I believe that it has been demonstrated beyond a question that almost all kinds of trees or vines pay better planted at some distance from each other than where they are too near. Now, as the profit to be derived from planting forest trees is the most important question of any to one who desires to plant a forest, I will commence at the beginning by supposing that an individual wishes to plant, say, sixty acres. This would take twenty-six thousand one hundred plants.

Twenty-six thousand one hundred plants, at ten dollars per thousand	$261 00
Planting them out	175 00
Plowing the land eight to ten inches	150 00
Harrowing and pulverizing	40 00
Man to cultivate and care for, six months	360 00
End of first year's work	$986 00

The second year will require a man eight months, at $60 per month, including team and board, which would amount to $480. After that there would not be any expense to amount to anything. Total amount the first year, in round numbers, $1,000; the second year, $500. I have made liberal allowance. Having had experience, I am prepared to say that these are the outside figures. If the trees are well taken care of when a year old they ought to average twelve to fifteen feet in height, and the second year thirty feet; and when five years old will pay a handsome profit. There being four hundred and thirty-five trees to the acre, eight trees when five years old will make a cord of stove wood, worth $9 per cord, which will cost half this sum to have it prepared for and delivered to consumers, leaving a net profit of $243 to the acre, or $48 60 net per acre per annum

for each year of the five; and in five years after there will be as much or more wood as at the first cutting. It is quite possible that this timber will be used for various purposes, in the near future, that will make it still more profitable. It will be readily seen that after the first planting there will not be any expense, as all that is ever required, after the timber is removed, is to take off some of the sprouts. There is no reason why one planting will not last for fifty or one hundred years, and pay interest on a value of $500 per acre. The best time to plant in this county is February or March.

MILTON THOMAS.

Los Angeles, California.

EXPLANATORY CATALOGUE

OF A FEW

FOREST TREES AND SHRUBS FOR CULTURE.

BY THE STATE BOARD OF FORESTRY OF CALIFORNIA.

"But I behold a fearful sign!
  To which the white men's eyes are blind;
Their race may vanish hence, like mine,
  And leave no trace behind,
Save ruins o'er the region spread,
And the white stones above the dead—
* * * —I would the plain
Lay in its tall old groves again.

Before these fields were shorn and tilled,
  Full to the brim our rivers flowed;
The melody of waters filled
  The fresh and boundless wood;
And torrents dashed and rivulets played,
And fountains spouted in the shade.

Those grateful sounds are heard no more,
  The springs are silent in the sun;
The rivers by the blackened shore
  With lessening current run;
The realm our tribes are crushed to get
May be a barren desert yet."

—BRYANT'S *Vision of "An Indian at the Burial-place of his Fathers."*

USES OF FORESTS.

If forests served no other purpose than to provide wood for fuel and timber for innumerable constructive arts, there would be less need to confirm and to enforce economic and utilitarian views which are so manifold and so manifest to us all. Nevertheless, a well certified basis of statistical facts upon any subject of inquiry serves greatly to enlarge the horizon of observation, and bring home to us some adequate realizing sense of the importance of the questions involved; and if for no other reasons than these trite, grosser, selfish considerations, an enlightened lumbering interest would surely command our earnest and active coöperation. But it is not to be supposed that this generation will prove unworthy sons of a patriotic and public spirited ancestry, for no wisely enlightened, social, or civilized man liveth solely to himself. Hence, the public domain—the whole people's patrimony, and their generations, in the largest sense of the general welfare, which we have inherited, in trust, for all time—must be generously passed onwards, with our share of use and of improvement, to children's children, unto all generations! This is the paramount present duty; the loftiest foresight, forethought, providence; in short, the good citizen's highest moral charity.

"Till the forested wilderness become a fruitful field, and the fruitful field be esteemed a forest."—XXXII Song of Isa. 12th.

After all hitherto deprecated by devoted lovers of nature and the most earnest scientists, the wisest statesmen and philosophers, still the fearful forest crusade goes on. When, too, the general will of the people is enacted by upright and practical legislators into the best forms of sylvan supervi-

sion, with due restraints on consumption, and waste of woods; and even, as it were, the amplest utilization of *all* their resources (so far as yet known); nevertheless scarcely a tithe of their wondrous uses can be justly said to be duly appreciated, mainly, let us hope, because their inestimable value to individual, State, or nation, and the wide world at large, is so little understood.

Let us, then, in the briefest possible manner, bring forth out of the common treasury of knowledge a few preliminary reasons—new and old—why trees lay claim to our high consideration. Passing strange, as it may seem, we *all* need line upon line, precept upon precept, upon paper, for lack of the heart of a noble and wise humanity within us.

It is because these great social and civil questions require joint action as well as individual effort, that Boards of Forestry in every enlightened nation of the world are now a conceded and urgent necessity. In the vast and ever increasing realm of man's material interests, it is impossible to overestimate the value of trees and shrubs to the wealth and prosperity of a nation, or of mankind in all the habitable regions of the great globe itself. Among the highest forms of the vegetable kingdom, therein they are the militant police, the picket guards, rank and file of those others that undoubtedly rule by "divine right" over all the subordinate products of earth. Fain as we are to enlarge we must be brief.

It would be interesting, could we spare space and time, to trace with some degree of fullness the beneficial effects of forests on clime. Like outer bars and reefs, that divide and conquer raging currents and rolling billows, so also do trees in the firmament above the waters, likewise endless, twig, spray, branch, limb, and massed body, the wind-waves of the great aerial ocean, storm-tossed too and tempest-born, into our own calm desired haven, the quiet human habitation of shelter and of repose. As vast masses of air can not be uniformly superheated over broken forested areas, they banish cyclone and sirocco, blasting and mildew, limit the ravages of rust and other fungi; not only forestall the breeding of locusts and numberless insect plagues and pests, but stay their progress and give ample shelter and protection for their compensating enemies in kind, besides feathered aids of every wing; they lay quiet finger on the chill and most trying norther, and next to the sun itself, render subtropical culture possible in the northernmost temperate zones; retain, restore, and equalize humidity, and, as before suggested, control the flow of springs and streams, lakes and wells; condense as by precipitating visible and invisible streams, also draw the passing cloud to refreshing shower, and not only arrest passing fever-laden miasms, but prevent the original formation, probably nearly all more or less, notably *eucalypti*, some of which absorb three or four times the sickening marsh that our oaks and elms are wont; and hence, evaporate a like amount of purified and salubriously camphorized and well medicated humidity to slake the thirst of a feverish atmosphere. We have thousands of similar sylvan alembecs ready at our bidding to sweeten earth and air, abounding in large stomachal or breathing pores, like insects, and exhaling ethereal fragrance, creating aroma, almost equal in rapidity with the lightning of the thunder cloud itself; hence, they disinfect by natural vital processes, and also mechanically bar the deadly progress of unnumbered plagues. They are also the natural home and secure retreat of feathered insectivora and the song bird, greedy of living pests and the tree-destroying mistleberry. Like some animals, these subserve as primitive forest planters, and may, ere long, with the useful insect aids against the common enemy, receive some just protection and fostering care at our hands.

It cannot be too strongly impressed, as suggested, how forests draw and condense the moisture of clouds, lowering temperature in Summer and raising it in Winter to a more moderate mean; in short, by all ways and means of varied conditions mitigating our lot—sheltering men and animals, fruits and fields—even to the dollar and cent estimate of millions of millions annually; nay, the very earth itself from exhausting sun, wind, and soil-wasting washes of the stormy season. Then their decaying leaves lend a spongy, mulching mantle to retain these rains, and to cushion the hoof of herd and flock, lest the tramp and traffic of men and things mortar the clayey loam while yet too wet, as it were, to tales of brick-mud, and so left bared of nursing bush to bake hard and impervious as the stone in the burning sun—whence the rough, almost lifeless, deeply-fissured bark—ready prey to the beetle and other borers—for wheresoever the expiring carcass is, thither do they gather themselves together to be in at the death.

Vigorous trees in spreading prim, let it be remembered, reabsorb a large amount of moisture from the air at all times, as well as restore never-failing dews that refresh the vegetation of their extended vicinity. These exhaled dews are not of the filthy, sickening, fen-sucked sort, but "sweet as the breath of kine that feed on ambrosial meadows;" their roots also powerfully loosen and lift up even the lower subsoils, or disintegrating the high places they bring down from the great mountain storehouses of nutrient materials the potash of rocks and other needful chemical supplies—always prospecting below and bringing up from the deep moraines over which they grow abundant renewed rich, ready-made soil ingredients for man's varied uses. In a word, their lofty masts and broad sails, unfurled to every breeze, bound on the long voyage of ages, yet is ever bringing bountiful supplies unto all living; but who among us can recount all their munificent benefits—who knoweth the metes and bounds of their electric and more occult spheres and compensating benign influences—their high, ruling endeavor toward the balances of power in the vegetable realm—the principal part they play on the boards of the great theater—and altogether what music they render in the orchestral harmonies of nature, in her grand oratorio!

Reference to trees as to food for men and animals, for clothing, and for medicine, and the like, the merest hints must suffice; and we purposely avoid poetic, artistic, and sentimental sympathies, or as to sacred represented types of invisible and eternal realities, or as to any hoary superstitions of the past, or hypothetical credulities of the present, but chiefly and somewhat narrowly limit these notes to secular uses only.

Concluding our needful proem, a pertinent question arises: Would it bring this very brief sketch into stronger light and bolder relief by casting in a few black shadows? If so, let us return and view the subject from opposite, or disorderly contrasts. And just here a thousand instances multiply upon us; but take a miniature typical example—a continent in the small—under the most favorable conceivable auspices; an isle (Mauretius), the "pearl" of the Indian Ocean, resorted to by invalids from all parts of India on account of its salubrity, being one mass of verdure; at length the forests were all cleared off for sugar planting; forthwith the rainfall almost ceased; rarely a thunder shower any more; rivers dwindle to muddy, lingering streams; lagoons, swamps, and marshes, especially along the seaboard, now no longer filled with waters, gave off noxious gases; little sluggish streams became filled with impure wash-water and obstructive refuse, and although often inundated in the rainy season, anon followed by dryness, augmented by faulty sewerage, fevers of a low type set in, against which

the usual remedies proved utterly valueless. Men often fell in the field, and died in a few hours; and this, mind you, in mid-ocean! (So reports Dr. H. Rogers, of that isle, who insists that the forest on the plateau must be replanted *for sanitary reasons alone*, as given by the celebrated Ferdinand Von Mueller, of Australasian Forestry Commission, and republished in California by Mr. E. Cooper.)

We have seen this whole programme enacted in the self-same series on Silver Run, and several other streams in Alabama, Georgia, south, west, and southwest to Texas and elsewhere, numberless neighbors in apparently perfect health, attending their usual round of morning and day duties, fall in the field, and laid out a corpse before night. Nay, we have attended whole cohorts of thirty to forty on a single plantation, all down at once, and this, time and time again, where we have pioneered the practice of medicine, more or less, Atlantic or Pacific, now well-nigh half a century. These present observations could be multiplied *ad libitum*, to very weariness, were it worth while, for the rank and file of those to whom such an appeal is likely to be of any benefit at all; could cite published facts of the day of hundreds upon hundreds struck dead by filthy ditch-mud, until it was somewhat a little easier to cart off dead humanity than "slickens." Indeed the whole subject is a matter of such universal notoriety it seems a pity not to mention something an average intelligent people do not know. The only plausible excuse to offer the public for these platitudes is that we do not in general sufficiently *realize our peril*, or something else too heinous to be dealt with in this way. However, there must always needs be the last appeal; the final reply e'er the consummated end come.

Is it really not enough for the inordinate rage of gain that hill and plain be dismantled tenfold to indefinitely beyond any needful present wants; but this boundless, nay, lawless cupidity, with instigations dire, must be doomed to invade all our high sources of prosperity; yea, run riot, if not wantonly mad—firebrand in hand before their perverted herds and flocks, up over our high forestal heritages, as we have seen unnumbered times, with ten thousand other citizens who can bear similar witness, if, indeed, any mountaineer of traveled age can be found on the Pacific who has not? It is with reluctance and the profoundest shame we are obliged to confess other people's sins, as well, but, thank heaven, we are not compelled, as yet, to confess that the whole remnant of the populace have fallen upon an utterly evil age emulous of personal and temporary gains regardless of consequences—that evil spirit which neither fears God nor regards man—present living men, nor their posterity. We are well aware the appellate motto of many leading minds is, "what has posterity done for us that we should care for them?" The stark effrontery of this looty sentiment could be seriously answered in the most burning and scathy fires of heaven's own glittering spears * * * but 'twere better left to slay its own offspring. Such a fearful first-born sentiment hath in itself ruin enough, yet let no one lay the flattering unction to his heart that this brazen lack-principle will cease from the ground of its own evil greed to flout in the face and eyes of a just and wise public policy legions of lies, high and low, subterfuges, fallacies, and frauds, with all the sophistical hordes begotten and born of it. Neither will it ever in anywise desist from its vicious vandalisms, were reasons offered high as heaven—staunch as the foundations of the world, and plenty as the best berries in June; therefore, for these and their following no one ever indites. But it would be one of the greatest wonders of the age if any sentiment so vile, so despicable, could be found as to have no public champion! nor do we flatter ourselves or the public that any array of statistics, historical observations at home or abroad, the world

over—explanations lucid in the light of ages, or focused as the sun of heaven, expostulations, exhortations, or threats will avail one iota. Therefore, *the time hath come for action*—the judgment of a just retribution, or due reimbursement by *law*—national and State, general and local, and if so be, the authority of these too are to become so bewebbed and wrested that there is no national, civil, or technical remedy to stay the sylvan cataclysm, then we appeal to the eternal bar of infinite, infallible, natural law that hasteth to summary execution by man's own loosened evils, for the fast times are upon us, shortening the days.

A word of reply is due the plausible plea for a negative "let alone" policy, *i. e.*, leaving trees to drift wholly in the tide of unregulated supply and demand, speciously urging that "more wood is springing up again than we have destroyed." This is true only to a limited extent in a few primitive cases where the prairie and the broken upland forest fires have been checked, or some half-open woodland intersections inclosed remote from the tramp of traffic, perhaps difficult of access and little pastured. Most of these and similar rejoinders do not bear investigation, and those that do only serve to confirm and illustrate accepted forestal experiences and established views, *e. g.*, meliorating bleakness, and so nearly or quite doubling the hardiest of all crops—grain. Examples from all parts of the world witness the axiom that no country can be healthy, wealthy, or in any permanent and proper sense prosperous, without a due and orderly proportion of woodlands. Without living wood for fuel, with facility of access, it is conceded every industry must languish, to say nothing of climate (of which we have already spoken; but too much can hardly be said on this point). Is it not remarkable that Norway, *e. g.*, can grow all our world-renowned conifers? Yet the frosts of the wine regions of Europe kills them! So true is it that any land once deforested and so deprived of its mean clime and aereal humidity, is made difficult or incapable of reproducing its own primeval or most desirable trees. The former state is only recovered by slow and orderly steps known, even though latitude, longitude, isothermals, thermometer, barometer, etc., offer no indication of change, yet becoming devastated and deserted more and moreover with a continual languishing; and to say nothing of health, or adequate food for subsistence, and all other considerations derivative; or what avails when the soil itself has fled and little but bare and barren rocky hills despoiled and left, mid and lowlands overlaid, fruitful vales deeply buried, richer bottoms spread with debris and sour silt, becoming a desert—outlying arid plains only waiting the drifting sands to complete the sad havoc. What signifies it, then, if a man did, on a transient time, get together a little *filthy* lucre by maternal pillage, is it any consolation to the wise and good to know that the spoiler migrated from the field of his self-imposed public ruin to work more mischief somewhere else?

NOTE.—At the outset it is due the public to say that the State Forestry Board have neither ways nor means provided for exchanges with similar bodies, foreign or domestic, upon any substantial and worthy basis—however hopeful we may be of the future—we feel ourselves under obligations to requite labor duly, or at least to reciprocate service for service. So far as mere plans and purposes respect one common end, ideal exchange is practicable; we trust by devotion to local conservation, and the collation of available information, with perhaps the contribution of some little original work, we may be fairly able to suggest a few such trees and shrubs as can be commended to the high consideration of our fellow citizens, so that with such aid as our selection from the ten thousands may afford, they may thereby be the better able to select their tithe also. To the intelligent and appreciative reader it is obvious enough that any explanatory catalogue from its very enumerative necessities must be brief; we have, however, seen fit to extend the limits somewhat in treating of trees and shrubs natives of our own country and coast, including a few foreign ones of more eminent promise of economic use.

Our own, with every other enlightened State of the age, is making earnest efforts to devise some means, however small the beginning, for the tests of botanic gardens, forest, and park reservation grounds, whereon the native sylva shall be cherished, and trials of foreign trees and shrubs can be made as well. Of late both the General Government and the States also, are manifesting the most enlightened statesmanship upon this and kindred subjects; already both the General Government and States seem duly coöperating to the same desirable end. With all honor and gratitude of their constituents, let us cherish the hope that in wisdom they may yet see fit to go on and reserve the most magnificent forest on the face of the globe. A portion of the Yosemite meadows also might well be devoted by us to Alpine and sub-Alpine species; these and private grounds ought to be munificently endowed; meanwhile, we must counsel together what are most promising for local culture and commendable to the intelligence of private culturists for their own trial, profit, or public spirited examples of more extensive industrial value. It is needless to dwell on the vast area of diversified soil and clime of this heaven-favored land, where, as it were, nothing comes amiss from the wide world, for it is all comprised in the ancient cognomen—*The New World.*

THE PINE FAMILY.

(*Coniferæ.*)

The pine trees, firs, junipers, cypresses, spruces, larches, yews, and Ginko Deodara, and several foreign trees, form a very natural group of the noblest, if not also the most useful timber trees of the globe—gigantic in size, for the most part, towering like palms in dignity, and, with but few exceptions, evergreens—in commerce known as "deal, fir, pine, spruce, cedar, redwood," etc. This most important order is principally found in the temperate climes of North America and from various parts of the world, in Europe, Siberia, and China, and some from arctic to the hottest regions of the Indian Isles. They yield largely resins, pitch, tar, turpentine oils, "Burgundy pitch" (of *Pinus Sylvestris*—similar of *A. Canadensis*), "Hungarian balsam" (of *P. Pumulis*), a fragrant incense resin (of *Arancaria brasilensis*), a "Copal" (of *Damara Australis)*, "Strasburg turpentine" *(Abies* pectinata, *P. Picea L.)*, "Bordeaux turpentine" (from *P. Pinaster)*, "Canadian balsam," from *Abies balsamea* or the "Balm of Gilead fir," larch *(larix)* "Venetian turpentine," also a "manna" when dried, "Gummi Orenbergense," like gum arabic soluble in water, "Aliquid storax" (of *J. Communis* or *Callitris quadravalvis?)*, besides very many other properties too numerous to mention here, but worthy, perhaps, of hints under particular species.

CONIFEROUS TREES.

Great Washington Cedar *(Sequoia gigantea)*.—The most colossal tree of the globe; between three hundred and four hundred feet high; diameter, thirty to forty feet, or more—*e. g.* at three hundred and fifty feet, eighteen feet through; age-limit unknown—many thousands of years; growth rapid, with great adaptability; a majestic and grandly graceful evergreen. conic in youth, aspiring in advancing age, and at length domed; wood light, soft, straight-grained, red, scarcely less lasting than the granite of the mountains upon which it grows, at an altitude of five thousand up to eight thousand four hundred feet. The timber has a wonderfully wide range of uses, but no disingenuous or stupid plea of "old, half rotten forests" can be urged for the reckless ruin of these trees of honor.

Redwood *(S. Sempervirens.)* An evergreen colossus of the Pacific Coast of California; only second to the mammoth cedar of the Sierra Nevada Mountains; two to three hundred feet, or more, high; fifteen to twenty feet in diameter; heart-wood of lower body heavy and lasting as the true cedar; wood, red, soft, free-grained, the upper parts light and brittle, like the big trees not troubled with insects, and equal range of use. But this

species only thrives in fogs. In our experience it pines when afar and away from its favorite sandstone or serpentine soil; attains to thousands of years—almost indefinite age—in cool or temperate humid coast haunts is of rapid growth. But it's the silliest of all vaunting to say "there will never be any scarcity of this timber in our country." The child is already born that's doomed to see the last of it—at the present rate of ruin—and yet live to no great age to speak of.

SOUTHERN *(Summer-green)* SWAMP OR BALD CYPRESS (*Taxodium distichum.)* A grand massive columnar tree of great value, one hundred to three hundred feet high, ten to fifteen, rarely twenty feet in diameter; wood, fine compact texture, durable; yields essential oil and superior turpentine; like larch and ginko the leaves fall off in Autumn; superior for swampy lands, avenues, or lakes, and river margins; of superior growth and very great age.* From Massachusetts to San Antonio, Texas.

California Incense Cedar (Libocedrus decurrens.) An elegant large tree, one hundred and fifty to two hundred feet high, four to eight feet in diameter; the arbor vitæ spray like "large honeycombs of green;" is even thrifty on dry hillsides; best at six thousand six hundred, but extends to eight thousand five hundred feet; kindly adaptable; wood, soft, light, stiff, dull creamy hue, very durable, like the world renowned cedars, holds spike and nail well, makes best of ties, boats, and all cedar uses in general, besides neat, sweet, odorless butter and fruit boxes, etc.; cinnamon bark rather thick, of spongy longitudinal fibers; grows rapidly and lives to great age.

Larix tetragona. A North Chilean species, of the Andes; two thousand to five thousand feet. Grows to one hundred and twenty feet, with a very straight stem. Wood quite white; highly esteemed for a variety of uses, nay, deemed most precious.

L. Chilensis. In cold valleys of southern Andes, Chili; two thousand to five thousand feet altitude. A fine tree, eighty feet. Resinous wood; hard; yellowish color.

L. Doniana. North island of New Zealand; up to six thousand feet. One hundred feet high, three or more diameter. Wood hard, resinous, dark red color, fine grained; makes excellent planks and spars.

JAPANESE UMBRELLA FIR *(Sciadopitys Verticillata).* A lofty and singular tree, one hundred and forty feet high; resists severe frosts. Wood white and compact.

YEW *(Taxus baccata).* Tree of middle and southern Europe and Asia, but generally only a shrub; up to four thousand feet. Wood yellow or brown; exceedingly tough, elastic, and durable—the joy of turners. The tree is of very slow growth; age to thousands of years; one of renown fifty feet girth.

FAR WESTERN, OR PACIFIC, YEW *(Taxus bravifolia).* Tree forty to seventy-five feet high, two to three feet in diameter; sap whitish, heart flesh colored; hard, tough, and elastic; cold coast creeks; to five thousand feet; rather slow growth.

CALIFORNIA MOCK-NUTMEG TREE *(Torreya Californica).* Best types one hundred feet high by four feet through; forty feet clear shaft, in redwood forests; easy to cultivate; free grower; tough and very durable timber.

CHINA MOCK-NUTMEG TREE *(T. grandis).* A tree sixty feet high, with umbrella-shaped crown; good timber.

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* *Montezuma Cypress*—(*T. mucronatum.*) Far-famed forests of Mexico, one hundred and twenty feet high; about fifteen feet in diameter.

Japanese Mock-Nutmeg Tree *(T. nucifera).* Tree thirty feet high. From the nuts the Japanese press an oil for food. Nuts very astringent; probably the ones used by the Japanese interpreter *äd coercendam drinam*, if detained too long in the Imperial Council Chamber.

Florida Mock-Nutmeg Tree *(T. taxifolia).* Tree fifty feet high; wood firm, close grained, durable, reddish color.

Widdringtonia juniperoides. South African; three thousand to four thousand feet above sea level. A middle-sized tree, rich in resin.

The following allies of the Yew are unsurpassed for the uses of beauty, elasticity, durability, longevity, and, what is remarkable, rapidity of growth:

Nageia (Podocarpus) *cupressina.* (Chomorö) of Java and Phillipine Islands; one hundred and eighty feet high; one of their best timber trees.

N–a (P–s) *totara.* "Mahogany" Pine of New Zealand. Fine tree; one hundred and twenty feet high, six to seven feet through. Wood reddish, close grained, durable, valuable for building, furniture; extensively used as telegraph poles. Most useful timber of New Zealand.

N–a (P–s) *lamberti.* A stately tree of Brazil; most valuable timber.

N–a (P–s) *purdieana.* Of Jamacia; a quick growing tree to one hundred feet high; two thousand five hundred to three thousand five hundred feet above the sea.

N–a (P–s) *dacrydioides.* The "Kalikatea" of New Zealand Maories, "White Pine" of colonists; one hundred and fifty to two hundred feet, four to six through. The white, sweet fruit eaten by natives. Wood pale, close grained, and heavy, yet used for canoes; for swampy lands. Antiscorbutic beverage, like spruce beer, made of the twigs.*

N–a (P–s) *amara.* On the high volcanic mountains of Java; large tree, sometimes two hundred feet high.

N–a (P–s) *spicata.* "Black Rue Tree" of New Zealand; eighty feet high. Wood pale, soft, and durable.

N–a (P–s) *thunbergii.* "Gulhout" of Cape of Good Hope; splendid wood for building.

N–a (P–s) *Ferruginea.* The "Miro" (Black Pine) of northern New Zealand; eighty feet high; wood reddish color, very hard; its dark red resin bitter.

Among the fern foliage types of these trees are some of exceeding beauty and highest use, most of all suited to rural residences, and of rather rapid growth.

Ginko biloba L. (salisburia adiantifolia. Smith). Ginko tree, of China and Japan. A straight, colossal tree, of one hundred feet or more, ten to twelve feet in diameter; summer-green foliage, of fan form, like the maiden-hair fern, of great elegance and beauty; fruit size of damson plums; by Japanese, seeds esteemed for promoting digestion; wood white, soft, easy to work, and takes most beautiful polish. The edible seeds when pressed yield a good oil. It is estimated that the tree attains to three thousand years of age; of easy culture; flourishes very well here.

Phyllocladus rhomboidalis—Celery Pine of Tasmania. A stately tree up to sixty feet, two to three feet in diameter; ship-mast timber; grows only to advantage in deep, sheltered valleys in crowded forests.

Podocarpus trichomanoides—Celery Pine of New Zealand, northern island; also called "Pitch Pine;" tree seventy feet high, of straight stem, three feet diameter; pale, close-grained timber for ship planks, spars, etc. Maories dye red and black from the bark.

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* Probably *Dacrydium taxifolium* is this same tree.

Fitzroya Patagonica. A stately tree, closely allied to the arbor vitæs, over one hundred feet by fourteen; the wood red; all but imperishable in open air or underground; does not warp; is easy to split; great variety of uses besides coopers' and carpenters' work; the bark yields strong fiber for caulking ships, etc.; like most trees of very cold regions, requires planting in the mountain forest.

SALT MARSH SHRUB (S.W. Australian *Actinostrobus Pyramidalis*—Mig.); *Frenela Actinostrobus*—Muell. Although only a shrub, placed here because so desirable for planting on coast and bay salt marshes, as well as our alkaline desert flats, where other conifers do not readily succeed.

Frenela Verrucosa. Useful tree for binding coast sand, as also drifting desert lands of the interior.

F–a Maclayana. New South Wales. A handsome tree, of regular pyramidal growth to the height of seventy feet; timber valuable.

MONTEREY, OR LARGE-FRUITED CYPRESS. *(Cupressus Macrocarpa.)* Magnificent shade and shelter tree of bleak coasts, sixty to one hundred feet high, nine in diameter; the quickest growing conifer known, except (Pinus insignis), "Monterey Pine," P. radiata; even thriving fairly in poor, dry soils.

LAWSON'S CYPRESS, *Chamœcyparis Lawsoniana (Cupressus Lawsoniana)*—Murr. North California. From one hundred to one hundred and fifty feet high, two to six feet diameter; handsomest of all the cypresses; wood white or slightly cream-tinted; soft, fragrant, elastic, durable, clear, and easily worked; great adaptability to situation under culture; grows freely.

Dacrydium cupressinum. Native "*Rimii.*" Red pine of the colonists of New Zealand; stately tree; two hundred feet; wood hard and valuable; eligible for forest valleys; suitable for cemeteries, on account of its pendulous branches.

Dacrydium franklini. The "Huon Pine" of Tasmania, found only in moist forest recesses; suited to similar cañons here; one hundred feet; five to seven feet in diameter; wood highly esteemed for ship building and various artisans' work.

(*Cupressus nutkaensis*) *Chamœcyparis Nutkaensis*—Spach. "YELLOW CEDAR" of Alaska; tree one hundred feet high; wood yellowish light; fragrant, strong, and exceedingly durable in the most trying exposures; superior for boat and ship building; bast for mats and ropes; suited to cold, wet coasts, from California to Alaska.

C–s benthami—MEXICAN CYPRESS. Five thousand to seven thousand feet. A beautiful tree, sixty feet high; wood fine-grained, and exceedingly durable.

C–s lindleyi. Mountains of Mexico; a stately cypress to one hundred and seventy feet high; timber excellent.

C–s obtusa, of F. von Muell (Retinspora obtusa—S. and Z.) Japan. Tree eighty feet by one to two; forms the great part of the forests at Nipon; wood white veined and compact; when planed of a beautiful silky luster; their temples made of it—N. B. Some varieties with golden, others silvery foliage. Two other very graceful cypresses of Japan are worthy of introduction, to wit:

C–s breviramea. (Chamœcyparis breviramea, Maxim;) and

C–s pendens. (Chamœcyparis pendula, Maxim.)

C–s pisifera—F. von Muell. (Chamœcyparis pisifera—S. and Z.) Japan; tree thirty feet; ornamental; variety of golden foliage.

C–s sempervirens; the COMMON CYPRESS OF SOUTH OF EUROPE. Tree to eighty feet, and famous for great age and durability of timber; next to

imperishable; much sought after for the manufacture of musical instruments.

C–s thurifera of Mexico. Three thousand to four thousand five hundred feet above sea. A handsome pyramidal tree upwards of forty feet.

C–s thuyoides (Chamœcyparis Sphœroidea—Spach.) This is the WHITE CEDAR of cedar swamps of Eastern United States, in low moist morasses. Tree eighty feet tall by three feet in diameter. Wood light, soft, fragrant, fine grained, and very durable, famous fencing, for shipping, boats, shingles, and wooden vessels, and no end to manufacturing and art uses. Suited to lands undrainable and of no other use—easiest of all forest culture. Seed sown in Autumn broadcast on ground or water surface. Seed here germinates in a few months—at East often requires six to eighteen months. Wood though white when cut, turns faint rose-red by exposure.

C–s torulosa. The NEPAL CYPRESS of North India, four thousand to eight thousand feet above the sea; tree one hundred and fifty feet by five feet in diameter; the reddish wood fragrant, and durable as the Deodar cedar; highly valued for furniture, etc.; prefers *limestone* soil.

C–s McNabiana. McNAB CYPRESS of California Coast; a tree of moderate proportions, ten to thirty feet by foot or more; foliage in somewhat flattened fan-spray, soft glaucous hue, pyramidal form; a very handsome tree, suited to the foregrounds of landscapes and limited lawns, and needs no pruning. Timber excellent; of rather rapid growth.

C–s goveniana, or DWARF CYPRESS of California. Tiny tree, three to ten feet; in ample fruit bearing at three feet; dense upright growth; seed deep purple to jet black; very pretty for limited localities.

C–s guadalupensis. This ISLAND CYPRESS, thirty to forty feet high, two to five feet in diameter; sheds its bark, leaving smooth surface of claret-red; valuable for timber and for ornament for coasts near sea level; like most cypresses, thrives in rocky relatively barren soils.

Dammara alba. Rumph. (D. orientalis. Lamb).—Agath Dammar. Indian Archipelagus and main land. A large tree, one hundred feet high, trunk eight in diameter; straight and branchless two thirds. Of very great importance; yields the famous transparent Dammar resin, extensively used for varnish.

D–a Australis. Lamb.—"KAURI PINE." North Islands of New Zealand. A magnificent tree, at least one hundred and eighty feet and seventeen inches in diameter; seven hundred to one thousand in age; excellent timber for masts, furniture, and almost every other purpose, besides the Kauri resin of trade.

D–a macrophylla. Santa Cruz Archipelagus. A beautiful tree of one hundred feet, like *D–a alba.*

D–a moorei. New Caledonia—fifty feet.

D–a obtusa. New Hebrides. A fine tree, one hundred feet high, long clear trunk, like *D–a australis.*

D–a avata. New Caledonia, rich Dammar resin.

D–a vitiensis. In Fiji, tree one hundred feet high.

SUGAR PINE OF CALIFORNIA—*Pinus lambertiana.* Elegant tree at all ages; cones, a foot to one and a half long, pending from the tips of long spreading or slightly depending branches—one to four together; two hundred and fifty feet high by twelve in diameter; lumber, soft, not so white as *P. strobus;* leaves, in fives, of nearly equally fine needles, and feathery; altitude, nine thousand feet; does not seem to flourish well below three thousand; timber, exceedingly valuable for a thousand purposes; wood, heavier and stronger, otherwise closely allied to the white pine.

Pinus Monticola—M. AND WEYMOUTH, OR PACIFIC WHITE PINE. A tree

of the *Strobus* section of pines—Pacific analogue of N.E. *White pine;* resembles the preceding, on a smaller scale; habit and foliage, similar; wood, white, soft, and valuable; from eighty to one hundred feet high by three to six feet through; altitude, seven to ten thousand feet above the sea; California and Oregon. These cones, although a little larger, greatly resemble the following. A dwarf variety, fruiting at three feet; tiny cones, madder-purple.

Pinus Strobus—The Great White (Weymouth) Pine of North America. A stately tree of supereminent beauty, one hundred and fifty to two hundred and fifty feet high, five to eight feet in diameter; of rapid growth; flourishes well on poor sandy soils mainly; most thrifty on a moist sandy loam; rarely in rocky, half swampy soils; very adaptive to a variety of soils and conditions corresponding to the temperature of Northern United States and Canada, even extending to latitude fifty-four north. The wood is very light (next to poplar), soft, and durable; has a wonderful wide range of uses, but lacks strength; so remarkably free from knots, it is greatly preferred for masts; fitted for all finishing and inside work, as it easily polishes to the greatest beauty; takes painting and gilding in a remarkable degree; choice wood also for the carver. The long, soft, plumy tufts of lively blue-green leaves extend so far back makes it one of the most effective, mildest tempering pines for shelter-belt against fierce, harsh wintry winds, even when very young, and for this purpose alone is immensely valuable.

Pinus flexilis—Limber Twig Pine. A sub-alpine tree eighty to one hundred and twenty feet high, three to five through; at an elevation of about nine thousand feet; of rapid growth; conic symmetrical shape; foliage somewhat similar to white pine; wood coarser, harder, and stronger—miners speak well of it, but their tests are too recent to warrant any reliable word of its durability. We think likely to flourish well throughout the temperate parts of the Pacific; cones elongated, egg-form, three to four inches; scales thin and like the bark of the body, gray, this latter only moderately rough, being rather slightly creviced. In every manifest respect unlike the following very distinct species.

P–s albicaulis—Clark's Crow or Gray Jay Pine. Along the highest timber-line margin of the Sierra Nevada Mountains of Mono to Shasta, and from the Rocky Mountains and New Mexico north to British Columbia and Montana, at ten thousand to twelve thousand feet, from these heights of depressed prostrate shrubbery it becomes forty to fifty feet high by one to two feet diameter where less buffeted by wintry storms. The trunk-bark thick, deeply cleft, and coarsely gaping, of a clean, lively, cinnamon-brown color, branches and twigs mostly whitish, hence specific name; cones common egg-form and size, purple to madder-brown; scales thick, smooth, and shining, dull pointed; small edible seeds, apparently wingless, the choice food of Clark's crow; wood yellowish, tough, and durable. As the sap in living cones, when bruised, turns to a rich violet hue, it would doubtless yield a splendid violet dye.

P–s balfouriana—Panther-Tail Pine. Tree of moderate size, fifty to eighty feet by two to four in diameter, of regular pyramidal growth—rarely the lower branches in age depending—long, slender terminal twigs with short, rather close pressed, very dark green leaf needles in fives, extending far back from the tops, *i. e.*, persisting ten to fifteen years, hence they impress one with the peculiar fir or spruce likeness after the similitude of *panthers' tails*, hence the common name; cones subcylindric, about four inches long, thinnish scales, outer disk margins swelled, central prickles early falling off; seeds pale mottled and winged to six or eight lines in

length, widest in the middle; this forest forms a very dark green, almost black, belt nine thousand to eleven thousand feet above sea level; quality of timber not yet fairly tested; bark of the body thick, dark reddish brown, coarsely open fissured.

Variety *aristata*, we have not seen. Tree fifty to one hundred feet high; cones with less elevated disk than the above; egg-shaped, and every way more like *flexilis*, with sharp, slender, awn-like prickles; found in Colorado, Rocky Mountains, Inyo Mountains.

P–s torreyana—TORREY PINE. A low coast pine, thirty to forty feet, by one to two thick, broadly branching, more or less awry by buffeting winds; the straw leaves, stoutest of any known pine; aspergiled at the ends of stout twigs, in boots of fives; cones rather large, about four by four and a half inches; old straw beehive-shape, and no hooks to the scale-disk; half-close, color dull madder-purplish; short wing inclosing the large edible seed with a very thick rim, readily falling away. Southern California, between San Diego and San Pedro. Timber reputed good, but scarce.

P–s sabiniana—SABIN'S NUT PINE. This "Gray Pine" belongs to the hot and dry foothills, mainly of the middle rolling lands and Coast Ranges of California; rarely over fifty to seventy-five feet high, about two to three feet in diameter, roughish ash-gray bark; leaves in threes, eight to ten inches long, light, thin, gauzy; tops of tree open-forked, or branched like the more common deciduous trees, and hence, moderately rounded head, yet the glaucous, smoky-green verdure, like a lady's vail that hides not the beauty beyond, so neither this the landscape; hence, a famous foreground tree; gives depth without obstruction, and lets fall a soothing softness over the scene. Cones deciduous, massive, six to ten by four to six, and clustered; very large nuts edible; wood white and soft, but not brittle; of quick growth in dry localities; found from near sea level up to three thousand or four thousand feet elevation.

P–s coulteri—THE GREAT CONE COULTER PINE. A broadly branching conifer of magnanimous aspect, dome-topped, lightish gray-green tint, the very long and large clay colored close-cones persistent. Seeds black; much smaller than the Sabine pine, while the wings are five or six times longer. Cones oblong (ten to twelve inches); scales like grizzly's claws; leaves in long needles nearly a foot in length and rather rigid. Well adapted for a sixty to seventy foot middle-ground tree. Three thousand to four thousand feet. A tree of rapid growth on dry coast hills and vales; body dark. The wood said to be brittle; but of this we have no knowledge.

P–s insignis (radiata)—MONTEREY PINE. A handsome seashore or Pacific pine, eighty to one hundred feet high, two to four feet thick; of remarkably rapid growth, even on these drifting sands, which it tends greatly to fasten; also forms excellent shelter belts against the fierce repressive blast that either kills or cripples nearly all culture. Sown broadcast and uncared for, only a few years serve to establish notable groves—in youth yielding to storm, yet wont to right itself up again whenever the wind lulls. Wood tough and of good repute; needle leaves, in fours and fives, three to five inches long; the brown varnished cones, clustered, bent forcibly back against the branch, obliquely swelled outward at base, where it is strongly knobbed; otherwise, in outline short ovoid, point incurved; three to five inches long by two to three thick. The cone remains on and closed many years; seeds black and rough.

P–s Haleppensis—ALEPPO PINE. Tree eighty by five feet; young timber white, old dark; for ships and furniture. Yields Venetian turpentine and tar. Thrives well in waterless, rocky places, and on sandy seacoasts.

P. maritima is a variety of this species. Content with the poorest and driest localities, and of rapid growth.

P–s pinaster—CLUSTER PINE. Like the preceding, on the shores of the Mediterranean. Tree of quick growth; rises to sixty feet. Wood soft and resinous; yields largely the French turpentine. Among the best for consolidating coast lands and converting rolling lands into pasture and agricultural soil. For easy rearing and rapidity of growth, one of the most important of all pines.

P–s pinea—STONE PINE. Bordering as above. Sixty feet. Wood light, white, and full of resin; for ships, buildings, and furniture. Cone similar to *insignis*. Seeds edible; ripen only in their third year. This pine grows as easily and almost as quickly as the cluster pine.

P–s pinceana—WEEPING PINE. Of Mexico; up to nine thousand feet above the sea. A very remarkable pine, of drooping branches like the weeping willow, sixty feet high. Most desirable for shelter curtains, for cemeteries, and for ornament.

P–s Pseudo-strobus—THE MOCK–WEYMOUTH OF MEXICO. The most elegant of any Mexican pine; eighty feet high.

P–s pyrenaica—PYRANEES PINE. South of Spain, on the Pyrenees. A fine ornamental tree, of quick growth; eighty feet high. Wood white and dry; free from resin.

P–s excelsa—LOFTY, OR BOOTAN PINE; Asiatic "WEEPING PINE;" LUMSHIRE," and at *Nepal*, "CHYLLA." A tree forming large forests of Himalaya Mountains, six to eleven thousand feet. A very fine pine, one hundred and fifty feet high. A valuable white, close-grained, durable, resinous wood, besides furnishing a good quantity of turpentine; branches white; growth rapid under care of Mr. Klee, at the State University grounds.

P–s Canariensis—"CANARY PINE." Canary Islands; forming large forests at five or six thousand feet; seventy feet high; resinous, durable, very heavy wood, not readily attacked by insects; branches in whirls; manifests great celerity of growth.

P–s Longifolia—Emodi, or CHEER PINE. Himalaya Mountains, two to seven thousand feet. Handsome tree, branchless; stem fifty feet; wood resinous, red variety; useful for buildings; yields a quantity of tar and turpentine; stands exposure and heat well.

P–s Larico—CORSICAN PINE. Southern Europe; one hundred and twenty feet; wood white; near the center, dark; very resinous, coarse-grained, elastic. and durable; esteemed for building, especially waterworks; three main varieties—*poiritiana*, in Italy; *austriaca*, in Austria; *pallassiana*, of Black Sea; grows best in chalky soils, and in poor sandy soils, where, however, the timber is smaller and not so good; yields all the products of *P. sylvestris*, but in greater quantities; perhaps the most resinous of all pines.

P–s muricata—BISHOP'S PRICKLY–CONE PINE. Of the Pacific Coast; tallest in peaty bogs; seeks sandy seashore, and found up to two thousand five hundred feet above; often a moderate sized tree, of twenty-five to fifty; rarely over one hundred feet high; slender; one to three feet thick; bark, reddish brown; needle leaves, in pairs, four or five inches long, often very slender; cones close set in spreading whirled clusters of four to seven, rarely ten or more, egg form, somewhat one-sided, with a down curved point, about three by two and a half; color brown, close, and persisting many years; central prickles of the scale-disks sharp; in the exposed southern coast form, strongly knobbed and spurred; the recent wood exhales the odor of apples.

P–s parryana—"PARRY'S PINE." Near the southern boundary line of California. A symmetrical compact conic *nut pine* of small stature, fifteen

to thirty feet high, ten to eighteen inches in diameter; leaves in bootees of three to five, usually four, of softened glaucous sheen; unsurpassed as an avenue tree. These and like trees lay quieting hand upon the natural dust by the wayside, or sandstorms of the desert, saying to the troubled elements, "*Peace!* be still." Common to low altitude, two thousand to three thousand feet.

P–s parviflora.—"GOYONOMASU," Japanese name. Small pine twenty-five feet high by one; much used for an avenue tree; wood fine for furniture and boat-building.

P–s monophylla—ONE–LEAFED NUT PINE. Of California, up to about six thousand, mostly on the eastern slope of Sierra Nevada Mountains, in the most arid localities, fifteen to forty feet high; usually low, rounded, scrubby outline; foliage, gray-green. Cones subglobose of few scales, with large blunt knobs, apparently wingless seeds, a most important article of food to the Indians.

P–s massoniana (Sinensis)—of China and Japan. Tree of sixty feet; supplies resinous, tough, and durable wood for buildings and for furniture; roots burned with oil of *Brassica Orientalis* furnish the Chinese lampblack, in cakes, for stenciling, etc.

P–s mitis—YELLOW PINE, SPRUCE OR SHORT–BOWED PINE. In dry sandy soil; sixty feet. Wood durable, resinous, valuable flooring. United States.

P–s hudsonica (Banksiam)—GRAY PINE. America, north to sixty-four degrees; to forty feet. Wood light, tough, yet easily worked.

P–s patula. Mexico, eight thousand to nine thousand feet; a graceful pine eighty feet high.

P–s ponderosa—HEAVY YELLOW PINE. Of Northwest America. From one to two hundred feet high, by four to eight in diameter, of comparatively quick growth; wood heavy, and for general purposes, preferred to other pines. Although found from three to six thousand feet, it is also well adapted to lower levels—strong, thrifty, hardy, and most generally distributed—does well on dry sandy soils.

P–s regida—PITCH PINE. Of Northeast United States and Canada. A conifer of deep dark green foliage and picturesque form and beauty; flourishes on poor, dry, gravelly, or rocky and barren hills, rolling sand plains, even down into the saline soils of spring-tide overflows; hence, adapted to unproductive and valueless shores, as well as dunes dangerous to contiguous fields, cities, and villages; in short, all places in lee of drifting sands, and is, indeed, a most excellent, rigid nurse and shelter for tender fruit and deciduous trees. A belt of white pine, backed by a belt of these to windward, would say unto the raging storms, "Peace! be still." Subdued, it would sigh and sing along the gale some sweet seremade of joys present or parting, pleasant and mournful to the soul. This is a tree all the way from nearly a shrub to one hundred feet high, by a few feet in diameter; bark black and excessively rough; needle-leaves in bootees of threes crowded or brushed on the tips of crooked upturned twigs; scales of cones sharp. Wood bright wine color, resinous, hard, strong, and durable, especially for ships, wheelwrights, floors, flumes, etc.; yields abundant turpentine, resin, pitch, and tar.

P–s resinosa—RED PINE. A tree forty to one hundred feet high, two to four feet in diameter, tall and slender, free below, bark in broad, smooth scales of reddish color; branches in distinct whorls, horizontal, at length declining, and upcurving to a line of beauty at the tips conspicuously bottle-brushed, with the long leaves in twos; a handsome object on the landscape; cones often clustered, two to four, egg-shaped, two inches or more at the end of the year; ripen at the end of the second season; wood reddish, fine

grained, rather soft, durable, and strong, free from much resin, and of quality between white and pitch pine, and grows as rapidly.

P–s serotina—Pond Pine. Of United States, south; in black, morassy soil, mostly near the seacoast; fifty feet high, one to two thick; wood soft.

P–s tœda—Loblolly Pine. The "*old field pine*" of the south United States, in poor, worn out, sandy soil; fifty to eighty feet; fine for inside work; quick growth.

P–s tenuifolia—Thread–Leaf Pine. Mexico; elevation of five thousand feet; forms dense forests; to one hundred feet tall and five feet in diameter.

P–s teocote—"*Okote*" or Torch Pine. Mexico; five to eight thousand above the sea; tree one hundred feet high by three to four; wood resinous and durable.

P–s tuberculata—Knobby Pine. One of the best Pacific Coast shelter pines; if much exposed, on poor, dry soils, is only a small conic tree, but inland, or in deep, secluded ravines, it rises to over one hundred feet high, and very handsome. Needle leaves in threes, four to six inches long, near a line broad. Cones hold on a whole generation, whirled around body and branches in circles of three to six or so, and strongly bent back against them, about five or six inches long by two thick, of conico-cylindric form, its sharp point incurved, outside obliquely swelled, and their back strongly knobbed, these subspurred or tuberculated scales, prickly top, a clay-colored close cone. Like most coast pines, of remarkably quick growth, only a little less than *P. insignis*, up to two thousand five hundred.

P–s abies (P. picea L.)—Silver Fir. Of Middle Europe, to fifty degrees north latitude, in dense forests; a fine tree; charm of the ancients; two hundred feet by seven; grows to three hundred years of age; most valuable building timber, and from its lightness, toughness, and elasticity suited for furniture; yields a fine white resin, and the Strassburg turpentine, similar to Venetian.

P–s australis—Southern Long–Leaf Pine. Of United States, North America; seventy to one hundred feet; the principal tree of the pine-barrens, whence our tar and turpentine and great pine supply of timber for building and extensive uses; poor, sandy, dry soils, loams, and swamps; a very adaptable tree.

The few following firs of the great Pine Family are the most lovely and the loftiest trees known. For regularity, symmetry, and a due degree of elegance, combined with dignity and grandeur, few sylvan objects equal them. They are readily distinguished by their smooth bark, often blistered, and table-tiered whorls of branches; leaves very short, single, and pine-like, seemingly set in two rows, extending very far back, leaving circular scars, and falling off, but not propped up on elevated bases, like spruces. Most conspicuously of all, discriminated by the *cones standing up erect, like birds upon the topmost boughs.* * * * Other marks might be mentioned, but here deemed best to omit.

Abies (Picea) *nobilis*—Noble Silver Fir. Of the Pacific West; truly a noble sylvan type of highest humanity; on mountains six thousand to eight thousand feet above sea level; sometimes seen two hundred and fifty feet high by four or five in diameter; the upturned foliage in perfectly level platforms of circling spray, successively lessening to the summit, silvery-sheened, and, as it were, velvet-lined verdure of amazing beauty, stateliness, and perfection; bark, cinnamon brown; cones oblong, six to eight inches, and about half as thick; broad bracts fringed and pointed, much protruding, and bent back so as nearly to cover the scales; timber known as "red fir," and best quality of the section, if we except *A. concolor.* Mount Shasta, locality in California.

A–s magnifica (Picea *amabalis*)—Magnificent Silver Fir. Of the Sierra Nevada Mountains of California; from seven thousand to ten thousand or eleven thousand feet; for loveliness and for towering grandeur this tree is unsurpassed in dignified port, like the *nobilis*, of which it may yet be considered only a variety (?). It grows to two hundred and fifty feet by five or six; sprays in similar sections of circles, silver-lined, and forms very dense fans of upwardly curving foliage, peculiar to most Alpine firs; bark reddish; cones very large, six to eight by three to four or more inches. Altitude eight thousand to nine thousand feet. This "red fir" timber, exposed to the seasons, seems too readily perishable. Yet some accord it the highest repute among firs.

A–s grandis (Picea)—The Grand Silver Fir. Of the Pacific Coast of North America. This very lofty species is two hundred to three hundred feet high by about four feet in diameter; bark rather even and brownish; wood white, soft, and coarse; in the southern form, leaves more distinctly two-rowed, bright varnished green above, two silvery lines below; sparser, hence a more light and airy head; var. *densifolia* is the same, only clad in a thicker Winter dress, suited to a more northern clime, just as we see in similar evergreens, too numerous to mention; cones cylindric, apex depressed-naveled, two to four inches long, by about one and one half inches thick; bracts hidden within; seeds with a very oblique wing, about as long as broad.

A–s (Picea) *concolor*—White Silver Fir. Of the Sierra Mountains of California; found from southern Rocky Mountains of Pike's Peak, Colorado, into valleys and foothills of New Mexico and Utah, etc., at about three thousand to seven thousand feet; the best quality of timber, exceedingly stiff, tough, strong, and durable, the farther west and on northwest exposures.

A superb *Silver Fir*, readily distinguished from its congeners by the softened pale, sea-green foliage; also the bark of the top parts being white, fading to whitish, and thence lower to ash-gray of the old fissured portion toward the base; besides it is notable that the leaves are longer than any other of our firs, when young two to three inches, although on old trees short, lower ones more apt to be notched, and, as usual with true firs, much bent up and crowding the foliage points upon the upper surface of the twigs, thus forcing them into a sickle-shape; near these upright cones, rounded on the back and always blunt pointed on flowering branches, keeled above and almost quadrangular, the scales are much bent up, so that a cone broken off shows the lower half deeply cupped, hence the seed-wing has also a strong lateral flexion. Nothing equals this timber for those enormous deep-mine pump-rods; also, being odorless and tasteless, it has no superior for butter and the like boxes, nor for wine casks, and for paper pulp, etc.; one hundred to two hundred feet high, by four to six.

A–s (Picea) *bracteata*—Fringe-Cone Fir. Of Southern California Coast Mountains, Santa Lucia only; an elegant steeple-shaped feminine Silver Fir, unsurpassed in aspiring beauty, combining all the merits the most critical amateur could desire; one hundred and twenty to one hundred and fifty by two to four feet; leaves like our Mock Nutmeg (*Torreya*); *i. e.*, long (two to three inches), line-like and sharply lance-pointed, of stiff and strong texture, in two rows—much more manifestly than other Firs; bracts scarcely longer than the *smooth* scales, but its mid-rib awny prolongation extends far out of the cone one to one and one-half inches, clothing the whole surface, as it were; fringed with recurving slender leafy awns. The upper smooth bark blistered with balsam crypts; cones egg-shaped, about

four by two and one half inches; three to six thousand feet above, and close to and overlooking the Pacific shore; timber elastic and very tough.

A–s (Picea) *Fraseri*—Double Balsam or Fraser Fir. At six thousand feet, on the mountains of North Carolina; a small tree, thirty to forty feet by a foot or so; bark smooth, cinnamon-brown; distinguished from the *Balsam Fir*, Balm of Gilead species, by the short and more oval cone, and very much protruding bracts between the scales, and bent back over them. This very handsome and deliciously fragrant little wintergreen tree, together with the following, yield the Canada Balsam used in the arts and in medicine; also found on the Broad Mountains of Pennsylvania, Saddle-back Mountain, Massachusetts; Green Mountains, Vermont; and Mount Washington, New Hampshire.

A–s (Pinus or Picea) *religiosa*—Oyamel Fir. Mexico to Guatemala, four thousand to nine thousand feet above the sea. A magnificent silvery fir, but the upper surface of foliage dark and glossy; cones oval oblong, three to five inches by one and one half to two inches thick; bracts more or less protruding between the scales and sharp pointed; these scales one third wider than high, and seed wings longer than wide. Fir one hundred feet high by six; wood superior for shingles.

A–s (Picea) *balsamea*—Balsam Fir. *Balm of Gilead Fir.* Extends from Canada and Northeast United States to mountains of Virginia, and beyond Mississippi River; larger tree than the *Fraser double fir*, seventy by one and one half feet; bark smooth and reddish gray when young, brown and cracked with age. The slender cones with the bracts inclosed (or barely the points rarely out) yields the *Canada balsam*, an excellent oleo-resin; a preparation of this used as a varnish for water colors, also for mounting delicate specimens for the microscope; the timber is light, soft, and suited to furniture; thrives best in a cold Alpine morass or mountain meadows, where it is of quick growth and admirable beauty while young, short lived, rough and ragged with age.

A–s (P.) *cilicica*—Cilician Silver Fir. Of Asia Minor; four thousand to six thousand five hundred feet elevation; beautiful tree of pyramidal growth, one hundred and sixty feet high; wood very soft, used extensively for roofs, as it does not warp; more properly a spruce.

A–s (P.) *nordmanniana*, several varieties. This of Crimea and Circassia, six thousand feet above the sea, is one of the most imposing silver firs; one hundred feet of perfectly straight stem or body, and yields valuable building timber.

Abies (Picea, P–s) *orientalis*—Sapindus Fir. Of Asia Minor; four thousand feet, eighty feet high, like the Norway spruce. The wood is exceedingly tough and durable.

A–s (Picea or Pinus) *picea*—Norway Spruce. Middle and Northern Europe and North Asia; rising from the plains to an elevation of four thousand five hundred feet, forming extensive forests; tree one hundred and fifty feet high or more; furnishes excellent timber for building and furniture; commonly known as *white deal*; yields Burgundy pitch in quantity, while the bark is used in tanning. Admirably suited to our cold, moist, foggy coast range, as also higher damp mountain ranges of the interior, and of Oregon more generally.

SPRUCE.

Picea (Abies.)

Distinguished from *Pines* by their steepled top and fine leaves, very short, solitary—usually appearing two-ranked—and always set up and jointed on to a little prominent thready-decurring-persistent base; relatively small cones, terminal and pendent on the tips of last year's twigs; scales looser, thinner, sub-membranous, maturing the same year and falling off entire, *i. e.*, not breaking to pieces like *Firs*, that leave the spindle-axis still perched on the top of their trees; nor do *Spruces* leave any *circular* scars of fallen leaves, theirs being rhombic; the seeds have no minute resin-vesicles on the surface, etc.

P–a Sitkensis (Abies—Pinus)—SITKA SPRUCE. A tall steeple-top tree, one hundred and fifty to two hundred feet high, three to nine feet in diameter, then rather flaky red-brown bark, very tough timber; cones, cylindric-oval, two to three inches long, less than an inch broad; finger-nail-like scales, loose, crimped, and finely toothed on the margin. In very enriched soils of old Indian lodges, beautifully and very long pendent curtain cord spray, producing the variety *pendula*, suggested by authors. It seems impossible to find a climate too rainy, or a soil too wet, if above the stagnant limit and below perpetual frost. From near the sea level to three or four thousand feet.

P–a (Abies) *nigra*—BLACK SPRUCE. Distinguished from the *White* by the darker, denser foliage, greater relative thickness of cone, and the loose scales being jagged on the edge; and from the *Hemlock*, by the leaves being equally distributed on all sides of the twigs; and the *Hemlock Spruce*, from both, moreover, by its very tiny cones. A tree forty to eighty feet, or even one hundred, by one to three thick; trunk, straight, uniformly tapering from ground to top; even bark, often whirl-branched; little, short leaves, four-sided and blunt; cones, egg-shaped, one inch or so long, lying point down; thin scales, wavy-crimped, and notched or toothed margin; ripe late into Winter; timber, white or reddish, famous for lightness, strength, elasticity, and durability, is even tougher than the *White*—famed for spars and ladders, being stiff—and unnumbered shipping and mechanical uses. *Spruce beer* from the twigs. Thrives well, even in dry soils, but prefers the swamp; is ornamental.

P–a (Abies) *alba*—WHITE SPRUCE. This is a very slim and wiry spruce of Northeastern United States, as seen densely groved in swamps—otherwise deemed worthless—rises forty to fifty feet or seventy-five, straight as an arrow; bark even and light brown; foliage bright, cheerful bluish-green, equally set up all around the twigs; cones variable to three inches, the thin, vellum-like close scales with smooth, entire margins; timber light, elastic, tough, and durable; young and tender sprigs used for making beer, and the tough roots used as cords and threads by the Indians. Seen by us as far north as latitude 60° in Alaska, also extends 7° or 8° further. Seeds sown broadcast in the Fall over swamps succeed well.

P–a (Abies, Pinus) *firma*—JAPANESE SPRUCE. A lofty pyramidally aspiring evergreen of nearly whirled boughs, lower horizontal branchlets subopposite; leaves straight or slightly upcurved, notched at the tips; cones pendent, cylindric-obtuse, five inches by one and one half broad, straight, or subcurved; thin membranoid scales, kidney-form, irregularly toothed on the rounded margin. Region of Lower Japan, one thousand eight hundred to two thousand feet altitude.

HEMLOCK SPRUCE.

Tsuga—Abies *Section.*

Tsuga (Abies.) Leaves petioled with very short, thready leaf-stemlets, jointed to a prominent, persistent, decurring base, which renders the twigs very rough when they fall away. Seeds with tiny vesicles.

Tsuga (Abies) *Mertensiana*—MERTEN'S PACIFIC HEMLOCK. In flourishing forms of the North Pacific Coast the very dense foliage of the hairy twiglets so crowd and confuse as almost to conceal its naturally two-rowed character: but in the milder climate of the North Coast of California it is a neat, delicate, airy, and gauzy beauty beyond description; most distinctly two-rowed, as it were, a spirit-tree, soft and ethereal as the haze of an Indian Summer. Tree one hundred to two hundred feet high by three to six; spiry top, horizontal slender limbs of graceful, cheerful, feminine reach, and upward sweep, or in age the gentle pending spray a little prone and picturesque: unsurpassed as a serene shelter-belt against damp, cold, bleak exposures; bark thick in age, and rough reddish-brown, live coating purple; wood whitish, strong-grained, and stiff, not very durable except as inside lumber; bark useful for tanning; cones similar to eastern: will almost grow on a bare rock with ceaseless rain and sweet moisture: if in comparatively dry soils we notice the roots still reach living water. Found up to two thousand feet or more. *Young and very thrifty timber;* is lasting. Civil Engineer Roberts says: "Railroad mudsills of small size (sound sticks) will last as long as white pine."

T–a (Abies) *Canadensis*—HEMLOCK SPRUCE. Common to Northeastern United States and Canada, mostly on hills and mountains; a very ornamental tree, excellent shade and shelter, one hundred feet high, wood whitish, coarse, and cross-grained, inferior save as sheeting and inside rough wood; bark very valuable for tanning, stripped off in Summer, spruce beer made of young shoots; the younger the tree the better the timber; among the handsomest evergreens of North America; no Winter shelter tree exceeds it.

T–a (Abies) *dumosa*—TANG SING. Boutan (Bootan) Himalaya region, eight thousand to ten thousand feet—S. K. Kim's "SILLOO HATARHEE" of Nepal: a very ornamental spruce, seventy to eighty feet.

T–a (Abies) *fortunei*. China, near Foo-Chow-foo; a splendid tree, seventy feet high, similar to cedar of Lebanon.

JUNIPERS.

Juniperus Section.

Junipers are evergreen trees, or shrubs, with usually opposite awl-shaped, or minute scale-like rigid leaves; tiny cones of scales, so united as to form a sort of "berry," the somewhat leathery, oily coating including one to three, or more, bony seeds; the natural cosmopolitan redeemers of the desert.

Juniperas drupacea—PLUM JUNIPER. A very handsome long-leaved juniper, the "Habel" of Syria. Tree attains thirty feet; produces a sweet, edible fruit, highly esteemed throughout the Orient.

J–s excelsa—LOFTIEST JUNIPER. Asia Minor, from near the coast to six thousand feet; sixty feet high: handsome pyramidal head: ashy, scaly bark, etc.

J–s Californica—CALIFORNIA JUNIPER. A low tree of the Pacific Coast of California; sheltered and in rich soil, rises to the dignity of a stout tree;

exposed on poor and rocky hills, prostrate; rarely over twenty to forty feet; superior fuel; berries large, shining brown above; scales scarcely visibly tipped at all; seed base (hilum) two-lobed, whitish; outline, egg-shaped; dry and sweetish.

Var. Utahensis. Smaller in all parts; fruit globose; Mount Diablo inland, and to Utah. These, in germinating, show four to six cotyledons; both forms of dense spray.

J–s Mexicana—MEXICAN JUNIPER. A pyramidal tree or bush; spray more slender; the two cotyledenous embryo eminently distinguishes this from the last.

J–s pachyphloea—THICK BARK JUNIPER. A middle sized tree; spreading, rounded top; thick, much cracked bark, and pale reddish wood. It is not easy to distinguish one juniper from another, but the thick oak-bark-like body, and four-angled seed, may suffice. New Mexico and Arizona.

J–s flaccida—DROOPING JUNIPER. Middle sized tree, or bush, with shreddy bark; branches spreading, slender, and drooping; leaves in pairs, with sharp spreading tips, and, like the last, slightly toothed; the tubercled berry scales sharp, and points bent back, including eight to twelve seeds; best distinguished by slender branchlets and rather spreading leaves; abounds in resin similar to Sandrach.

J–s occidentalis—WESTERN PACIFIC JUNIPER. Tree forty to eighty feet high, three feet in diameter; wood whitish, yellowish, or reddish, of several varieties. Of California and Oregon, Texas, Northeast Mexico, Arizona, etc., at five thousand feet or more. Berry blue-bloomed; one or many seeds.

J–s Sabina (var. procumbens)—CREEPING CARPET JUNIPER. They carpet rocks and sandy shores, and make an everliving lawn where nothing else can thrive. May be trained into everlasting hedges. Seeds one to three; rough. Maine and North, west to the Pacific.

J–s Virginiana—VIRGINIAN RED CEDAR, or SAVIN. The largest, widest spread, and most useful of all American junipers; pyramidal. Tree sixty to ninety feet high; wood red at heart, sap white; very fragrant; light, compact, durable. Small purplish berries, with glaucous blue bloom; leaves entire on the margin. Canada to Florida, and from North Atlantic to Pacific north. The common "pencil cedar." As an extremely beautiful, lasting, and densest of all hedges, in any soil, is unequaled.

J–s fœtidissima—STINKING JUNIPER. Of Armenia and Tauria. A tall and beautiful tree; Alpine; to six thousand or seven thousand feet.

J–s Mexicana—MEXICAN JUNIPER. Extreme Alpine; straight tree, ninety feet high, three feet in diameter. Exudes copious resin like sandrac.

J–s procera. Stately tree, of Abyssinia, furnishing hard and useful timber.

J–s recurva. On the lofty regions of Himalayas; twelve thousand feet or so. Thirty feet.

J–s spherica. Of Northern China. Handsome tree, of forty feet.

J–s communis—COMMON JUNIPER. At best about fifty feet. Berries used in preparation of gin; also for making an excellent beer, with barley. This species is characterized by the leaves in threes, and being line-like, awl-pointed, and spreading, and not as most others, of close-pressed scales. Hue glaucous, or bloomy-green. Frequently prostrate and creeping. Berries small, size of tiny pea; dark purple.

LARCH.

Larix Section.

Distinguished by the deciduous leaves being clustered in radiating spangles from little warty or woody buds.

L–x (P.) *occidentalis*—"PACIFIC WESTERN LARCH." A tree trim and true as an arrow, one hundred to one hundred and fifty feet high, two or three at the base, boughs short, slender, somewhat depending or "bow-on-the-back" sweep: the general structure of the oriental type—relative to other species, leaves long and slender, of light, thready, radiating, feminine airiness of foliage, color pale bluish or glaucous-green; in Autumn, before the fall, fading to a rich, leather-brown hue: scattered sparsely here and there by cool streams of shady cañons: timber heavy, hard, and very durable; the cones egg-form, an inch or more in length, fringed with bracts, reflexed.

L–x (P.) *lyelli*—"LYELL'S LARCH." Cascade Mountains, Washington Territory; a smaller tree, densely pubescent bud-scales and branchlets; cones more oblong. For waterworks, casks, shingles, ships, etc.

L–x (P. L.)—"EUROPEAN LARCH." European Alps, up to seven thousand feet: one hundred to one hundred and sixty feet: the valuable timber is of great durability, much prized for ship building and general uses; the bark for tanning and dyeing: of great importance for its yield of *Venice turpentine*—by boxing or boring in Spring, these fill during Summer, one half to three fourths of a pint. A variety, the "*Russian Larch*," about eighty feet, of immense value for uplands.

L–x (P.) *leptolepis*—"JAPAN LARCH." In Japan, between 35° and 48° north latitude, up to nine thousand feet. Timber highly valued by the Japanese.

L–x (P.) *pendula Americana*—BLACK, or TAMARACK LARCH. Vermont and New Hampshire, north—pyramidal to one hundred feet; timber white, heavy, resinous, very valuable, resists fire, neither shrinks, cracks, nor rots readily, and is very strong, but is of slower growth than the European; cones the smallest and leaves shortest; prefers cold swamps.

OAKS.

The OAK FAMILY are readily distinguished by their nut acorns in cups, and simple, alternate leaves.

Quercus chrysolepis.—CALIFORNIA (*Golden leaf*) CAÑON LIVE OAK. The largest evergreen oak of California: best types one hundred feet high by eight to ten feet in diameter, with one hundred and fifty feet or more spread, abounding in thick, drooping, graceful tufted sprays, massive knees of the choicest ship timber, equaling the Government Naval *Live Oak (Q. virens* of United States South Atlantic Coast); wood, white, very compact, heavy, tough, and durable, superior for tight wine casks, and as it does not warp nor season-crack, for mechanical and naval purposes has few if any equals. *In vernal vesture, both young twig and leaf, clad in soft golden velvety furze*, this alone distinguishes it. Leaves oblong, sharp, prickly pointed; on old trees mostly entire, base, blunt, or sub-heart form: bark, rather flaky and ashy-gray. Acorn cup like the *White Oak;* nut, similar; styles, short. A biennial oak; the best quality grows near the coast.

Q–s wislizeni.—The *Dark Domed Live Oak.* Wintergreen oaks, with solemn stillness of rigid foliage, deep, dark, almost black-green leaves,

body-bark blackish, and limbs livid and smooth, clean canopied, sixty to seventy-five feet high, timber tough, hard, and withstands friction well. Besides general features, the best test at all seasons for this species, where round-topped trees and foliage forms so commingle, is in the leaves being *finely netted with translucent veins, nearly alike above and below*; leathery, shining, and nearly flat, oblong, lance-pointed, size variable, similar to above. Acorn subcockspurred, often striped lengthwise, apt to be velvety at tips; styles, long; cup, deep liberty-cap like; scales horny membraneous; fruit set on short, stout stems, one to several together; matures the second year; young acorns form in the axis of young leaves and wait over to next year.

Q–s douglasii—Blue Highland White Oak. This Summer-green "*Pacific Post Oak*," of sundry other local cognomens, is essentially a foothill oak, prevailing over the middle portion of California up to two thousand or three thousand feet elevation. Tree forty to sixty feet high, rarely eighty; one to five feet thick, of the formal old apple orchard type. But this Blue Oak is rather dim and delusive; the bark almost as if whitewashed, or, in some cases, like the gray of *White Oaks (Q. alba).* It abounds on hot and arid rolling hills and highland levels; makes good fuel, and has some other utilitarian repute somewhat similar to eastern white oaks in our rural districts; distinguished by pubescent twiglets, winter buds, small, roundish, and nearly smooth; the leaves are small, one to three inches, and half as broad; the margin slightly bayed a little; light blue bloomy green, on very short leaf-stems; acorn set close down on a very short stem, cap hemispherical; scales more or less tubercled; acorn oblong, and tapering to acutish; matures the same year.

Q. lobata—California White Oak. Grandest of all Pacific oaks; but for timber valueless, except when young and very thrifty, then nearly equal to the best eastern *white oak (Q. alba).*

Q. oblongifolia—Evergreen White Oak. This oblong-leafed *Wintergreen Oak*, as usually seen, is a fine middle-sized tree twenty to forty feet, by two to two and a half in diameter. In the most favorable sites attains to sixty or seventy-five feet, by three to four through; the body, bark, and larger limbs of whitish gray, the final spray more open than most *live oaks.* In general, it has somewhat the spreading habit of the golden species, but the acorn in this is *smooth inside*, the leaf-stem very short (scarcely one quarter of an inch), blade blunt at both ends, one to two inches long, and one half as broad; soft, downy at first, but in age smooth and blue-bloomy; texture thick and leathery, few or no net-veins, rarely here and there a tooth; acorns apt to be set down, cups hemispherical, scales finely tubercled, nuts oblong one half to one inch. In southwest California, Chihuahua, and New Mexico. Wood hard, heavy, said to be brittle (?); leaves mostly deciduous in Spring.

Q. agrifolia—Field Live Oak. At its best this is a grand, imposing, robust, round-topped, wintergreen tree of maritime California. This pastoral oak branches hugely, low towards the horizon, even to one hundred and twenty to one hundred and thirty feet broad from a few feet above the ground; the dome top thirty, sixty, to one hundred feet high—massive; main body four to eight feet in diameter; bark thick, of blackish-gray, and in age rough and chinky; leaves apt to be variable, about two inches long, usually broad, egg-form, warped, convex above; hence vaulted below, no fine net-veins; main mid-rib, spreading, branched above the middle, and a little cottony on the axils; dull, leaden-green, the color fading out on severed twigs; acorns annual, thickened spur-shape; cup liberty-cap-like, flat scales, horny-membraneous; for the most part its leaves are fallen

by the early breath of Spring; wood strong, good fuel; best of the *Black Oaks*.

Q. virens—LIVE OAK. United States, of the southeast Atlantic Coast. A large wintergreen tree, shedding a few leaves in Spring, huge branches spreading low, curved, twisted, and kneed, seldom over fifty feet high, five to seven feet in diameter; main body eight to ten feet, but covering an enormous area of one hundred to two hundred feet span: of very rapid growth in favorable situation and soil: twelve to fifteen inches increase of diameter from the acorn in as many years: wood compact in fiber, heavy, strong, and durable—in short, the most valuable timber known in naval architecture: bark excellent for tanning, and lesser branches for fuel; grand avenue tree; form of foliage and fruit similar to the coast Golden Oak of California.

Q. cornea—HORN OAK. China. An evergreen tree of forty feet: acorns used for food.

Q. ilx—The South European HOLLY OAK. Tree of fifty feet; timber for ships and bark for tanning: from varieties of this, the sweet and nourishing ballota and chestnut acorns.

Q. incana—GREAT GRAY OAK. Himalayan timber tree of great dimensions; a beautiful evergreen.

Q. toza—South Europe. One of the handsomest oaks, and of the quickest growth; evergreen foliage.

Q. densiflora—CALIFORNIA EVERGREEN CHESTNUT OAK. A very large evergreen oak of great symmetrical beauty; seventy-five to one hundred and fifty feet high, seldom more: two to five feet in diameter: limbs not large, spreading horizontally below, rising to erect above, in general outline broadly conic; bark light gray, with the smoothness of luxuriant growth, unequaled for tanning, hence known also as TANBARK CHESTNUT OAK: catkins erect like the chestnut. Biennial acorns clustered, oblong, obtuse, top satiny, as is inside the usually shallow cup, and also the hard horny shell: meat bitter; outside of cup altogether mossy; leaves oblong, two to four inches by about two, sharp pointed, base obtuse on very short stout leaf-stem, parallel pinnate veined, margin toothed like a chestnut. A vast deal might be said of this choice tree but must be left in abeyance. In every way it greatly resembles the Asiatic SILK OAKS.

Q. infectoria—GALL OAK. A small tree of Summer green foliage; the nut galls of commerce chiefly from this.

Q. alba—WHITE OAK. One of the most valuable timber trees of North America; up to one hundred feet or more by two to seven feet in diameter; a Summer-green tree of exceeding elegance and beauty at all stages of growth: shrinks from constant sea breezes, and requires a cool, temperate, and sheltered clime: body branching low, save in the grove and forest, where the shaft is forty to fifty feet; limbs large and spreading below, spray above more erect and uniformly distributed: bark, light ashy to nearly white, finely cuboid chinky, buds small and round: membranous leaves a few inches long and half as wide, bay-lobed bluntly, three or four on each side: cheerful green and smooth above, soft gray-green beneath, on a rather short slender leaf stem: timber tough and durable: long exposed to sun apt to warp and season-crack. Uses almost universal, by ship-builders, wheelwrights, and all artisans. Elliott, of South Carolina, remarks: "The finest of *Q. alba* in United States, and probably in the world, is the country which incloses the Alabama and its tributaries." But is it possible to equal Michigan and upper waters of the Mississippi Valley? No forest tree possesses more good qualities than this.

Q. prinuus—SWAMP CHESTNUT OAK. United States, south. A magnificent tree, seventy to one hundred feet, of colossal pillared body, fifty to seventy-five feet without branches, surmounted by a regular head; four to six feet in diameter; smooth grayish bark; leaves large ob-egg form, coarsely toothed; less regular than chestnut, and slightly pubescent beneath; acorn large, egg outline one-half cupped on a short stem. In the same upland soil as *White Oak*, or by swamp margins, timber nearly equal or preferred in hot climate. Red dye from the bark. Foliage deciduous. *Q. michauxii* and *Q. castanea* confounded in name and use, only trivially distinct.

Q. montana—The MOUNTAIN CHESTNUT OAK. A tree belonging to the large division of Chestnut Oaks, but smaller; only thirty to fifty feet high by one to two; along the base of the Alleghany Mountains of East United States, in rough rocky situations, and coarse gravelly soils; hence, also known as ROCK CHESTNUT OAK. Leaves long, ob-egg form, white, velvety beneath, coarsely toothed; acorn and cup as the preceding, only half the size. Both timber and bark the most valuable of the *Chestnut-like section.*

Q. mongolica (Fischer)—"MONGOLIAN SILKWORM OAK." Mandaschuria. N. B. One of the two species on which mainly (if not entirely) the East Indian OAK-SILKWORM *(Bombyx Yamamai)* is fed and reared—an insect peculiar to oak trees, as shown by Dr. Hance.

Q. Serrata (Thunberg)—JAPANESE SAW-TOOTH SILK OAK. These two Asiatic *Silk Chestnut Oaks* so nearly resemble our California *Q. densiflora* as scarcely to be distinguished. This is one of twenty-three known oaks of Japan, and is said to yield the best food of any for the OAK SILKWORM *(B. Y*–, as above.) Specimens may be examined in the hands of Mrs. Hittell, of San Francisco, California.

Q. sideroxylon (Mountains, Mexico). An oak of great size, of compact timber, almost imperishable in water. In the cooler mountain regions of Mexico are many other highly important timber oaks, to wit: *Q. lanceolata*, *Q. chrysophylla*, *Q. reticulata*, *Q. laurina*, *Q. obtusata*, *Q. glaucescens*, *Q. halapensis* (Humb.), and *Q. acutifolia* (Nee.)

Q. squamata. One of the tallest Himalayan oaks; lasting.

Q. bicolor—SWAMP (Chestnut) WHITE OAK (by some only var. of *Q. prinus*.) Common on the lowland marshes of North America; variable; some very handsome; large size, eighty to one hundred feet, by five; bark rough, scaly; wood, brownish, heavy, compact, fine grained, and elastic; some boat builders prefer it to the typical white oak. Best identified by large leaves, six to seven inches, wedged at base almost entire, or a sub-lobe above the middle, whitish downy beneath; acorns on long stems, few, but sweeter than the *White* oak.

Q. macrocarpa—BUR-OAK, OVER-CUP, and MOSSY-CUP WHITE OAK. A handsome medium-sized tree of luxuriant foliage, and large, mossy-fringed cup, nearly inclosing the globular nut; sixty to seventy feet high by two to four diameter of body; bark ashen, smoothish; leaves large; lyrately lobed; narrowed at base; general outline broadening out above; pear-shaped; timber solid, smooth-grained, tough, stiff, and strong, durable; for wagons less liable to season-crack than *White oak.*

Q. tinctoria—DYER'S QUERCITRON, BLACK OAK. A large upland oak of rich soils, with spreading habit; sixty to seventy feet high; two to four in diameter; outer bark black, hence the common name; yellow within. The best test of the species is, chewed *it yields* a bitter *yellow dye.* "*Quercitron*" comes from the tree, and is rich in tannin; leaves darker, thicker, shorter, broader above, less bayed, and weak, powdery, hairy beneath, at least in axils and lobes shorter pointed than the true

Scarlet oak (*Q. coccinea*); also, the depressed globular or ovate acorn, with a *yellow* areolar base; cup and scales unlike; former set close down; latter short, pubescent, creamy within; wood good; Autumn foliage mostly yellowish to light russet brown, etc.

Q. coccinea—SCARLET OAK. A large tree, seventy to eighty feet high, rarely more; two to four in diameter; limbs little spreading, and form upright or of oblong top; nearly as graceful as the elegant *Pin Oak* (*Q. palustris*), and next to it the deepest bayed foliage, and these broadest at bottom, besides a longer leaf and leaf stem than the preceding, and the brilliant, open foliage in Autumn very ornamentally scarlet, hence the common name. Thin bark represents the relative smoothness of luxuriant growth; inner portion of light reddish hue, and yields no color, and less bitter on chewing, but abounds in tannin; acorn larger, oblong; cup with tapering base; white within; wood for staves, etc., inferior to the black oak, for either fuel, wagons, or other rural uses.

Q. suber—CORK OAK. Tree about forty feet high; acorn sweetish; age two hundred years or more; from south of Europe and north of Africa; evergreen. After twenty years it can be stripped of its bark every six or seven years, but the best cork is obtained from trees about forty years old and over. Flourishes finely in California, and proves of rapid growth at Fresno, Santa Barbara, and elsewhere. A plantation of these acorns would yield a never failing fortune.

Q. rober—BRITISH OAK. Extending through Europe and Western Asia; attains great age and enormous size. Of two principal varieties:

Q. sessiliflora—the DURMAST OAK. Darker and heavier wood, more elastic, less fissile, quickest of growth, thrives on poorer soils; bark richer in medicinal, dyeing, and tanning properties.

Q. pedunculata—ENGLISH ACORNED-STEM OAK. This variety supplies most of the oak timber of Britain for ship building, and is the best for bending under steam; also preferred for joiners' work.

Q. œgilops. South of Europe; tree of the size of the BRITISH OAK; cups known as "Valonia," for tanning and dyeing—unripe acorns as "Camota" or "Camatena," for same purpose; wood famous for furniture.

Q. cerris. South Europe; —— feet high, or equal to English Oak; in suitable localities of quick growth; foliage of Summer-green, or, also, Winter-green; wood in request by wheelwrights, cabinet-makers, turners, and for building purposes.

Q. phellos. United States, south—WILLOW OAK. A slender tree for height; along margins of marshes and streams; thirty to sixty feet high; bark dark leaden, smoothness of thrift; deciduous; leaves lance-linear, tapering each way like willow, smooth, thick; biennial acorn, small, round, cup shallow; timber famous for felloes; lasts thirty-odd years of severest constant use; never season-cracks.

Q. palustris—PIN OAK. An exceedingly handsome middle sized tree, with the most light, neat, and elegant foliage of any known oak; relatively tall, and slender limbs; small and set in the body, not unlike pins, hence the name, "*pin* oak," and "*palus*," also, a peg or pin; found on the broken hills of brooks and fountain streams of sweet drainage; also seldom along alluvial margins; leaves oblong, smooth, and shining, both sides bright green, very deeply pinnatifid-bayed, gracefully broadened near mid-rib; lobes spreading, cut lobed and toothed, and these acute pointed, on very slender stems, rather long and weak; fragrant, acorn globular, half inclosed, sweet; timber stiff, strong, and elastic, highly ornamental; has sweet galls. In Eastern States the tree is relatively small, say forty to fifty feet;

in the West to eighty or more; never in swamps (?); wood remarkably elastic, strong, and tough, though coarse grained.

Q. castanea—YELLOW CHESTNUT OAK. A very graceful tree, growing sixty to seventy feet high, two to four in diameter, in rather rich soils of the United States; leaves narrowed, oblong, acute, and sharply and regularly toothed; quite similar to the chestnut, soft, hoary, downy beneath; hemispherical cup, thin, with fine close-pressed scales; acorn small and sub-oblong; also further distinguished by the very yellow wood and flaky bark. The timber of this beautiful tree is strong, elastic, and well suited to wheelwrights.

Q. rubra—RED OAK. Tree of one hundred by four or more feet; wood of little value, never known to season, and almost fireproof; bark rich in tannin; Autumnal tint of foliage beautifully red; only of landscape use.

Q. Kelloggii—PACIFIC BLACK OAK. In Yosemite Valley, California, this oak is over one hundred feet high, and more than eight feet in diameter; in Autumn, beautifully golden-hued and ornamental; timber said to be the best of the black oaks when well seasoned; only a Summer green tree, with open foliage; between the Eastern black and scarlet oaks; bark black and rough.

Castanopsis chrysophylla—GOLDEN LEAF PSEUDO CHESTNUT, or *California Evergreen Golden Chestnut.* Abounds in the redwood region of California Coast Range. Largest on the rich red loamy rolling hills about fifteen miles inland. Over one hundred feet high and five to eight feet in diameter; clean columnar body of colossal proportions, fifty to eighty feet without limbs; bark of the true chestnuts. Leaves thick, leathery, smooth above and dark-green golden-velvety beneath. The male flowers like the chestnut. Bur horrent with branching spines inclosing one to three hard-shelled nuts, of shape, taste, texture, and similar form to the BEAKED HAZEL *(C. rostrata).* Timber splits well, works easy when green, hardens as it seasons, is tough, elastic, and lasting; stains and polishes finely; ornamental, of glistening faintly reddish tint. The "Chinquapin" var. minor is only smaller—on dry, fogless hills, comparatively. Found from Oregon to Monterey, up Sierra Nevada, to six thousand feet.

C–s argentea—PSEUDO-SILVER CHESTNUT. Mountains of India. Yields an edible nut. Timber valuable. Has also its *minor* shrub-form variety.

Castanea Sativa—Miller *(vesca)*, var. *Americana*—The AMERICAN SWEET CHESTNUT. Among the largest and tallest trees of the ordinary forest; massive, pillared, trunk clean of branch, and diminishes little—like our *Golden Chestnut*—up to fifty or seventy-odd feet, and thence rejoicing to one hundred and fifty or more; five to eight feet in diameter. Bark light brown, the swift-water-line-crevices apt to be broad but superficial; more rough in great age; the large lance leaves regularly rib-veined to a coarsely and sharply toothed margin. Foliage turns to a cheerful yellow in Autumn ere it falls away. Catkins of male flowers erect, straight, in clusters radiating the tips of the twigs; the ball bur at their base horrent with spines and inclosing one to three nuts, sweeter than the foreign. In dry rocky, gravelly ridges, of light yellow loamy soils, generally, on the North American continent. Common to South Europe, and temperate Asia, these woods abound, and the timber, though coarse grained, is in general request as it is light, somewhat elastic and strong, resists vicissitudes of seasons nearly equal to the best, and when well seasoned by age it neither shrinks, swells, warps, nor cracks; hence, famous for large wooden cylinders and many mechanical structures that require nice stability. A most valuable tree, whether for shade or shelter, timber or fruit. It also attains to

great age and size. Mt. Etna tree two hundred and four feet or more in circumference.

The Beech is a lofty, spreading tree of damp and cool regions of the globe, notable for its smooth, white or bluish-gray bark, sharply three-cornered oily nuts, one and two in a mossy, four-cleft bur; male flowers of pink and yellow, tassel-like, are hung on long silken threads; females seated in pairs. Few species—half dozen or so—distributed in Europe, Asia, America, and Australia. Mostly deciduous, with fan-folded buds.

Fagus—AMERICAN BEECH (var. *Americana*). This is an elegant tree. but by no means massive nor masculine; sub-conic, from sixty to eighty feet high, numerously branched, every two or three larger, thus alternating and in-filling its canopy to greater depth: the fine twigginess of branchlets gives it close shade and fine, delicate sheltering qualities, unites softness of foliage and symmetry of form. Best known by the spindling Winter buds, tasseled male flowers hung on long silken threads, females seated in pairs, later-on the sharply three-sided nuts in a mossy bur, or, at-length in a little four-lipped urn; leaves oblong egg-form, taper pointed, coarsely toothed. In this Summer-green garb it always presents a neat and clean, delicate and cheery verdure; nuts sweet; wood closely homogeneous, grain hard and smooth, sap wood best, more durable, tougher, and least liable to warp. For planes, bowls, trenchers, and trays, chairs, for tools and turnery, fuel, etc. Thrives best on rich, damp, rocky soils on a close substratum of clay.

F–s dombeyi. CHILEAN EVERGREEN BUCH OR COIHUE. Of grand dimensions for canoes of ten tons freight; the wood harder than the following other Chilean species, although otherwise their qualities are similar. As this extends to the Chonos group, and perhaps still further south, is adapted to middle Europe and North American forest culture.

F–s obliqua. The ROBLE of Chile, by aborigines COYAM. A tall tree with a straight stem, three to four feet in diameter; wood heavy and durable, well adapted for posts, beams, girders, rafters, joists, etc., but not for flooring. This is one of the few Chilean trees with deciduous foliage, says Dr. Philippi.

F–s procera. Known in Chili as RAULI; also deciduous, colossal, wood splits well; adapted for staves; finer grain than *obliqua*, and much used for furniture. (Dr. Philippi.)

HAZEL, FILBERT.

Corylus.

The hazels are mostly shrubs, or low trees, common in the cooler zones; the caterpillar-like catkins come out very early, pending the tips of twigs; the fertile or females, like recurve-radiating pink threads; the fruit-husk, like a cap, from old Saxon, *heesle*, a cap; hence, *Hazel;* also, the botanical, from the Greek, *corys*, a helmet, or *Helmeted-nuts*. As California and the Pacific Coast of United States includes the most promising latitudes, besides being favored by a relatively more genial clime, well broken drainage, and humid breezes suited to culture of the lesser nuts. as well, we devote more space to their notice than first intended, because so little attention has hitherto been devoted to them, to the manifest loss of annual millions to the State.

Corylus Americana—AMERICAN HAZEL. In the native wild state a Summer-green shrub, six to twelve feet high, with erect branches, leaves roundish heart-form, angled and toothed, downy beneath, on a short leaf-stem;

fruit burs large, round-clustered, cut-leafy-like-lipped above the nuts, which are numerous, and by brief culture equal if not superior to foreign species, *e. g.* a single bush in Princes' garden gave half a bushel of nuts in a season. They require little or no care; could be planted on the borders of fields, to say nothing of their adaptability to any soil, to the roughest, rockiest, and most forbidding, and we might add, otherwise useless localities; besides, their roots do not obstruct the growth of grass in pastures. Only the best results, however, come from culture; the European Hazel, no better than ours, Mr. Webb, of Calcot, England, reports raising two thousand six hundred pounds on an acre, which sold for $900, besides apples, pears, and potatoes from the same land; but all such marvels require high culture. They come into bearing from the seed in three to seven years.

C–s avillana—European Hazel. A shrub about eight to twelve feet high, branching and suckering like our own native species, and equally suited to almost any soil; planted for the nearest, say eight feet three inches, which gives six hundred and forty to the acre (although we should prefer twelve to fifteen feet); ground to be dug once a year, or better deep plowed. Keep a clean crop of potatoes, or the like, between, and they come into bearing in five years. My Bro., Maj. H. K., of the East, found them to fruit in three or four; ours by express were given Hon. Geo. Hobler, of Alameda, and lost, but with care, we feel safe in saying six or seven years here would bring them into prime bearing. It is a pleasure to refer to Mr. Webb, of Calcot, England (a nut culturalist and author of a pamphlet on "Nut Culture"), who says he employed six laborers a quarter of a day gathering off of one tree, all witnesses to the weight of one hundred and ten pounds of cobnuts.* They are there considered certain bearers, six out of seven years; equal to the best perishable fruit orchards. There are, moreover, other points well to mention, once for all, relative to these and similar nuts. The market is always a sure one—transit easy—they are not injured in boxes, tubs, or barrels, for a few months, any more than flour, by sea or land, and if packed close in large mouth earthern jars, husk and all on, will keep perfectly fresh and sweet for at least one year, a damp cloth laid over the mouth simply. Given ample space in apple, pear, or plum orchards, crops can be also cultivated meanwhile. Over $1,000 per acre reported realized, from which we presume it is profitable.

C–s colurna—Constantinople Nut–Tree. Attains to sixty feet, the tallest of all the hazels, and is of rather quick growth. There are thousands of gulches that would support a little grove of these to profit, here and there, on this coast.

C–s heterophylla—Japanese Hazel. A promising species for trial in our coast range cañons.

Guevina avellana—Molino (*Quadria heterophylla*, R. and P.)—Chilian Evergreen Hazel. This hazel tree attains to the height of thirty feet; yields the hazel nuts of South America. Being of similar latitude and coast exposure, there is no reason why this would not thrive well here and serve the admirable purpose of shelter belts, with their annual bounty. One of the most lovely trees in the world; snowy white plumes of flowers simultaneously with the ripening coral red fruit; wood tough and elastic; used for boat building.

Corylus rostrata—Beaked Hazel. The Pacific United States variety of this shrub is four to twelve feet high, two to six inches in diameter, of flexile

* Cob Filberts or Hazels. N. B. The Cobnuts of Jamaica are the seeds of a Spurgewort or *Euphorbiaceous shrub Omphalea*; most delicious and wholesome, if the embryo is extracted (if this is not done they prove too cathartic).

and arching habit, suckers and spreads on moist and foggy coast, amid half shady woods; prefers broken and hilly situations; greatly abounds in Oregon, and has become of many millions of commercial value as hoops for barrels, kegs, and boxes. This hazel has roundish sub-heart shaped leaves, two to four inches long, on short leaf-stems, little angled and pointed above, with doubly-toothed margins, soft, downy-hairy; nut oblong, tightly inclosed in a green husk, which has a dudy fit below, lengthened into a snout or beak like a narrow necked flask, and jagged or ruffled at the tip; also distinguished by a dense velvety, somewhat nettly-bristly husk; those bunches of burs that grow on the ends of the twigs seldom perfect more than two or three nuts of inferior size and quality. The chief reason why this native species is noticed at all is as a natural guide to the most suitable situations, soils, and climes, for the better sort.

Brabejum stellatifolium of South Africa—we notice here although a Protead. The nuts of this shrub are edible, similar to the Chilian *Guevina avellana*, but the fruit is to be roasted, as otherwise it is deleterious.

Macadamia ternifolia. Nut tree of sixty feet (East Australia); taste of hazels.

Carpinus Americana—American Hornbeam. A small tree allied to hazel and oak, twenty-five to thirty feet high, by half to a foot or so in diameter; bark smooth, as in beech, and of bluish iron tint; hence, also called "Blue Beech." This color, and likewise hard quality of wood, has also given it the name of *iron wood*. The body is ridged like deer's horns, hence the name, and it equally signifies *hard beam*; bears the fruit in terminal, ragged, hop-like catkins, scales of it one-sided and leaf-like, laterally toothed, changed in this species into halbert-shape or three-lobed, formed into a flaring cup. The eight-sided seed or nut, in a close-fitting ribbed husk, sits in the axil, and, as it grows, crowds it more open; the leaves thin, soft, and like the sweet birch, but chewed have no spicy wintergreen flavor. The splendor of its Autumn hues of scarlet, crimson, purple, red, or orange, vies with tupelo, oak, maple, and the gayest of the sylvan train; body fluted, long pending seed tags, and altogether, presents a peculiar tree—a worthy ornament of easy culture near streams. Wood white, compact, and close-grained, of great toughness and strength.

Ostrya Virginica—Hop Hornbeam. The hop hornbeams are very handsome, small and slender trees, easily distinguished in fruit by the pretty pending cylindrical seed-vessel tags, two to three inches long, in general outline similar to a hop, formed of flattened bladder-like sacks inclosing the nuts. The exceedingly tough twigs have the dots on the bark lengthened horizontally, as in birch and cherry. On the body in age it cracks, scales up, and divides into very finely shreded fibers. Leaves similar to sweet birch, beech, etc., but more eliptical and long-pointed, its thin, delicate, and soft foliage, level-sprayed and tasseled, is remarkably ornamental. Wood wonderfully firm, stiff, and tough, famous for levers, hence called "*lever wood*;" and from extreme hardness, also *iron wood*, for cart-stakes, binding poles, gads, etc.—"Blackhazel," used for cogs, mallets, and mauls. On banks of streams six inches to a foot through, twenty to forty feet high. Autumn tints, shades of orange and yellow, brown, or russet. Of easy culture.

*Juglans**—Walnuts. These are best known by their undivided nut coat; the tags also are mostly single, but the leaves are made up of very many leaflets—five to twenty odd—in seven to ten pairs, and an odd one

*From Latin, *Jovis Glans* (Jupiter Nut)—from its superior excellence.

at the end. Lofty timber trees of north temperate regions, of great value, also bearing sweet and wholesome nuts abounding in oil.

Juglans nigra—Black Walnut. Eminently one of the most majestic trees of United States, Atlantic west; seventy-five to one hundred feet high, three to seven or more in diameter. The solemn domed head, of great magnitude, is of the priestly type; their massive mantled boughs, of large-winged but soft luxurious foliage, soar gracefully aloft and afar towards the horizon with easy dignity of motion, casting a dense, dark shadow that tolerates no undergrowth. Useful in all conceivable ways, and elegantly ornamental for avenues and public shades. Timber of finest grain for finish, and for gun stocks and much cabinet work superior to mahogany, famous for elegance, tenacity, hardness, strength, durability, etc. Growth from the nut, when planted where it is to remain, is both certain and rapid. Nuts, with due degree of culture and care in collection and preservation, as harvesting early, the shuck on and dried in the shade, equals the European: requires a rich alluvial soil. As the sap abounds in sugar, fermented, it yields the intoxicating liquor known as "walnut wine;" wood of dark purple or violet hue, deepening towards black with age.

It should be observed that nut-bearing trees, naturally of lofty growth, will not prosper if tap-roots and tops are cut away; their collateral lower branches being simply nurses and wood constructors; they build but do not bear; hence, their leader, both above and below ground, must be left alone—should be planted where they are to remain, or only transplanted very young, and for other manifold reasons.

J–s Californica—California Walnut. A favorite and elegantly ornamental shade and avenue tree of California, forty to seventy-five feet high, two to four in diameter. All hitherto known to us are remarkably shapely, oblong, cylindroid, or urn-topped, and umbrageous; possibly, in the decrepitude of age, it may prove alike picturesque with the *White*, or *Butternut* species *(J. cinerea)*. The combined leaf is of five to eight pairs of leaflets, and a terminal odd one; these are about two and a half inches long, narrowing from near the base into a sharp point; tags often in pairs, four to eight inches long; fruit globose, little compressed; surface slightly map-river gulched, or grooved, and almost smooth; shell very thick, the meat-kernel retaining its original sweetness and vitality for unnumbered years. For beauty, grace, richness of foliage, rapidity of growth, at all points of use for durability or ornament, it is unsurpassed by any deciduous tree of the Pacific Coast, but it requires the rich alluvial soils by the margins of streams to keep alive a good reputation.

J–s rupestris—Dwarf Walnut. A small shrub or tree, from six to twenty feet or so, well suited to limited lawns, unobtrusive foregrounds, and narrow avenues; tags two inches long; compound leaves of six to twelve leaflets, narrowed above the point, much attenuated; nuts, like good sized musket bullets: shell hard and thick. Texas and New Mexico.

J–s regia—The Royal Anglo–Asiatic Walnut. The common English or European walnut, originally from Central Asia; attains to eighty feet or more, and lives for centuries. These nuts of commerce are of world-wide use as an article of diet as nuts or oil, the latter also in the preparation of fine colors. For first-class fruit the trees are grafted. An almost huskless variety from North China can be grown in cold localities, as it thrives there on mountains, and even in middle Europe at two thousand feet. Nuts, with coats carefully dried on, and packed in casks between layers of dry sphagnum or moss, are sure to arrive in the best condition for germination, ready for planting where they are to grow, viz., in deep, rich, alluvial

soils. It is well known the wood is light and tough, etc., for the choicest cabinet work, gun stocks, and a thousand similar uses.

J–s Sieboldiana—Japanese Walnut. Thrives well in California, but for the best results requires strong land; cluster-fruited: nuts large and profitable for culture: best planted where it is to remain; cutting off tap root or top leader is a dire calamity.

J–s stenocarpa. From the Amoor territory; allied to *J. mandschurica*.

J–s cinerea—Butternut: This low, and at length broad-headed tree is thirty to forty feet high by two to four feet through: beautiful in youth, picturesque in age; best distinguished by its oblong, snouted nut, with its mummy-clad and clammy hide, or sticky, velveted skin: gathered so soon as early matured, and carefully dried in the shade, it is very sweet and pleasant flavored, and not liable to become rancid with age. The old bark is ashy gray, hence, also named White Walnut. Of very rapid growth and remarkably graceful in its upright, urn-form state into age, when it spreads abroad more and becomes flat topped and remarkably picturesque and prolific. A tree eminently suited to sandy and rocky soils, where the roots readily reach moisture, it also does well on bottom lands, borders of streams, lagoons, and lakes. Common in the northern and middle Atlantic United States. Timber light and bright tint for cabinet-work.

HICKORY.

Carya.

The hickory section of the Walnut Family *(Juglandaceæ)*—found only in America—have their tags mostly three-parted; the shuck of the nut opens by four seams, and the compound leaves of fewer leaflets, say five to nine—rarely fifteen.

They are all of them very stately, grand, and beautiful trees, whether seen in their Summer green and graceful foliage or in the golden gay and varied parade dress at the festive Autumn scene—always sylvan clouds of woodland glory. Wooing, they wave the wind with the grace and ease of a grain field, bow in princely dignity before the rolling storm; yielding to the fiercer tempests, as the good and true are wont to do, integrity of body or limb is never broken, but with wonderful toughness and amazing elasticity they ever return joyous victors over the warring elements; hence the useful, ornamental, clean shade, and secure shelter tree. They yield the most delicious of nuts; withe tough and strong; wood, as timber or fuel, is so excellent as rarely to be equaled, hence unnumbered uses. Exposed to moisture, however, the timber is not very durable.

Every species of hickory preserves one uniform towering tendency of their tribe, and may therefore close their ranks in the grove like apple and similar fruit trees. They can be best raised to advantage by germinating in a propagating house and then planted where they are to remain, but so plentifully as to allow for squirrels or the like depredators. They can be thinned to profit, to any required stand.

Carya alba—Shellbark Hickory. The Shell- or Shagbark has five large leaflets; shuck thick and deeply grooved at the seams, where it opens into four pieces, one larger; the nut suborbicular, slightly compressed and angular, and though they vary much in form are mostly large—one to one and one half inches by half inch wide, the best having thinner shell, fat or rounded and swelled form, with plump easily extracted meat of a superior sweetness. The richness of the kernel is apt to keep pace with the roughness of the bark. A beautiful, towering, and stately tree, often slightly

spread-urn topped. Seventy to eighty feet; about two (rarely three) feet in diameter. Grown by itself from early age it broadens more, but the branches of all the tribe are slender and seldom very open-headed. Abounds in United States east; thrives best in rich moist soils, preferring black humus among rocks and ferns, or rich loamy hillsides on the edge of forests or the borders of fields. The ashy-gray bark, as indicated, flakes off in long large loose plates, greatly warped up at one or both ends. It really seems very strange that a wild fruit of so great excellence should have received so little attention by enterprising and intelligent culturists, who could not fail to improve this as other fruits. And even as forests the timber is invaluable, splits well, and has so many manifold uses there is scarcely any end to enumeration of the uses of mechanics and artisans. The white sap-wood of the most rapid growth is the best; the red-brown heart, though strong and hard, is neither so tough nor elastic. The worst fault to be urged is that it warps and season-cracks badly; but it is not attacked by worms when in salt water.

C. sulcata—Thick Shellbark. This has seven to nine leaflets; oval fruit, four-ribbed above the middle, and furrowed. Nut strongly pointed, slightly flattened; thick yellowish shell. Timber as above.

C–a tomentosa—Mockernut Hickory. This tree is sixty to eighty feet high, about two feet through; bark relatively smoother than the preceding; in mature age furrowed, but fibers more or less interlocked; leaves large seven to nine leaflets, and these, with the twigs, very starry-wooly when young; the resinous hickory odor rank; this *white-heart*, *square-nut hickory*, so called in the one case where the growth is rapid, in low grounds—although in old age a small dark heart does exist—and in the other because some have nuts quadrangular-like, *i. e.*, with prominent, sharp angles, others with the shuck pear-shaped, and reluctantly opening more than half way, in this species becoming very hard; nuts very white, kernel not so easily extracted, shell thicker and harder; often grows in poorer soil, but more slowly, and the timber is not so good, but as fuel nearly equal to any; the fruit ripens in October.

C–a glabra—Pignut or Broom Hickory. A large tree, thirty to seventy feet high, one to three in diameter; the close bark finely checked but never shaggy; rather dark hue; very tough and slender branches numerous (sprouts used as *hickory withes);* common footstalk of leaves smooth, leaflets three to seven, narrow; fruit mostly fig-shaped; shuck thin, tough, and leathery, reluctantly opens part way; nut oblong, shell hard and not thick, kernel dark pellicled, its hazel taste becoming finally bitterish and astringent—rarely palatable; wood varies somewhat in quality with sundry varieties, with the general excellence of their class; in this species it is apt to be found in the greatest perfection, it is therefore preferred for axletrees of carts, heads of mallets and beetles, and handles of axes, whenever young and *exceedingly thrifty*, which may also be said of both the preceding; for fuel not to be excelled; affords a black dye by vegetable acids.

C–a amara—Bitternut Hickory. By some considered a variety of *glabra*, but we think sufficiently distinguished by seven to nine or eleven small, narrow, shapely, saw-toothed leaflets, which give it the slender, light, clear-cut grace of the ash, rising columnoid and urned up to fifty feet, and on up to sixty or seventy; very bright yellow bud, middle sized fruit globose, seams prominent; nut broader than long, wavy swelled surface, thin shell, kernel plaited or corrugated and intensely bitter, with powerful astringency; in swamps, or, if on dry and sandy soils, contiguous to streams or lagoons; affords a yellow dye; timber inferior to other hickories; among

beauties this is the most beautiful: the body even and symmetric; shape tapers gracefully; bark not at all shaggy.

C–a microcarpa—SMALL-FRUITED HICKORY. A symmetrical conic tree, forty to sixty feet high, one to two in diameter; upland, loamy woodlands of New England and Pennsylvania, southwestward; bark even, not shaggy; leaflets, five to seven oblong-lanced, saw-toothed, *glandular underneath*, but not downy; nut about the size of the hazel; husk thin, smooth, shell rather thin, and nearly even; kernel greenish pellicled, inferior flavor.

C–a oliviformis—PECAN NUT. This very handsome and valuable hickory of the Southwestern United States is like all of the tribe in favorable soils and climates, of the most rapid growth of any hitherto tested in California. The smooth leaflets, thirteen to fifteen, are saw-toothed, of lance-sickle shape, smooth; nuts, oblong, olive-like, and thin shell; meat, delicious; but to our taste none surpass the *shellbarks*. The Pecan tree is a refinement upon the aspect of the best types of the California Walnut, being more lithe and delicate.

The AUSTRALIAN MOCK HICKORY (is *Acacia Supporosa*). A tree fifty to one hundred feet or more by one and a half to two feet thick; makes tall, straight masts and spars; is exceedingly tough and elastic; fine for gig-shafts, handles, gun-stocks, etc. East Gippsland.

Pterocarya fraxinifolia—ORIENTAL PSEUDO-HICKORY. Of central Asiatic Russia; a kind of *walnut tree*, which, with *P–a Stenoptera*, Dr. Hance recommends to be adopted as trees both for ornament and timber; and so perhaps also the Japanese species.

Engelhardtia spicata is another SPURIOUS WALNUT of the mountains of Java and the Himalayas; reaches two hundred feet high.

Casuarina quadrivalvis—COAST SHE-OAK. Of southeast Australia; thrives on sandy, barren places even up into the inland hills; sixty feet; of quick growth; seeds early and copiously, easily raised; well tested in California; the male tree fine for avenues, drooping; cattle fond of the foliage; checks coast sand; one of the best for timber belts.

C–a suberosa—ERECT SHE-OAK. Forty feet, beautiful shady species; *C–a trichodon—Frederiana and Dugeliana;* all arboreous, and yield valuable timber. *C–a glauca*, DESERT SHE-OAK, widely distributed in Australia; in favorable places, eighty feet; wood hard, durable, remarkable for its rapid growth, for shelters, and most speedy supply of fuel, a remark that applies to all of them—the heaven-sent redeemers of deserts.

Ceratonia siliqua—CAROB-TREE. Of the Mediterranean; thirty feet high; resists drought well; wood, pale red; saccharine pods. Algaroba, or ST. JOHN'S BREAD, of value for domestic animals; seeds germinate readily.

Eucalyptus marginata—The JARRAH MAHOGANY. Of southwest Australia; famed for its wood, which is neither attacked by chellura, teredo, termites, limnoria, and other pests of the land and sea, and therefore so urgently sought after for wharves, jetties, and all naval structures; also underground work and railway sleepers. Vessels built of it have been able to dispense with copper-plating. The timber is very strong, close grained, slightly oily, and resinous. This property is also shared by the RED GUM-TREE *(E. rostrata)*, both of which are of rapid growth in Oakland, as Mr. Nolan fully tested on his grounds many years ago. This wood works well, makes a fine finish, and ship builders in Australia consider it superior to oak, teak, or indeed, any other timber. The tree in its native haunts is chiefly on ironstone ranges.

E–s ficifolia—CRIMSON-FLOWERED EUCALYPT of West Australia.

E–s rostrata.—The RED GUM of Victoria, South Australia, and river flats of the interior, or over the whole Australian continent. The wood is of

extraordinary durability underground, hence highly valued for fence-posts, piles, and railway sleepers; is also extensively used by ship builders as main stem, stern post, inner post, dead wood, floor timbers, futtocks, transoms, knight head, house pieces, cant, stern, quoter and fashion timber, bottom planks, breast hooks and riders, windlass, bow rails, etc. It should be steamed before it is worked for planking. Next to Jarrah (from West Australia), this is the best wood for resisting the attacks of sea worms and the white ants. (For details, see reports of Victorian Exhibitions of 1862 and 1867.) The tree attains to one hundred feet or more.

E-s amygdalina—Lofty Peppermint. In sheltered springy forest glens and deep rich ravines, both colossal and the tallest tree on the face of the globe; often measures four hundred and twenty in the Dandenong Range, and on the sources of the Yarrah, still higher; we have heard of them four hundred and ninety, or nearly five hundred feet—these not fully verified; those tested show the same amazing rapidity of growth as our specimens of *E. globulus*, but in open uplands is only a middle sized tree; the fresh leaves and twigs yield two to four per cent of oil. The wood is fissile, suited for rails, shingles, house building, for the keelsons and planking of ships, and for other purposes; the inner bark is adapted for all kinds of coarse paper; is found to flourish well in California.

E-s Stuartiana—One of the White Gums. Vicinity of Victoria; nearly equals the above *Almond Peppermint*, and only surpassed by *E. divirsicolor*, or *E. colossea*, which Mr. Nolan fully tested in California more than a generation ago; found also in Tasmania and South Australia; of the bark can be made coarse packing paper and pasteboards.

E-s obliqua—Stringy Bark. The main part of a wide extent of forests of barren mountain ranges of Victoria, Tasmania, St. Vincent Gulf to Gippsland; tree three to four hundred feet high; bark makes good mill and pasteboards; pulp bleaches readily; universally used for thatching, as it is very thick, bulky, and easily separates.

E-s globulus—Blue Gum of Victoria and Tasmania (not the *Blue Gum* of New South Wales and West Australia). Near the coast, in open spaces of diminutive size, but in deep declivities nearly as colossal and lofty as any of the preceding; stronger than teak or oak; ship carpenters' outworks, fence rails, and railway sleepers and ties last nine years; good shafts, spokes, etc.; well tried in California.

E-s longifolia—Woolybutt. A tall timber tree, like *Ironbark*, for spokes; has a high character for durability, for fences and as posts; lasts more than twenty years; superior fuel. From Victoria to East Gippsland.

E. leucoxylon—Ironbark. Suited to poor soils of high ridges. Locality as above.

E. melliodora—Box Peppermint and Yellow Box. On low open ridges of Victoria miocene; a middle-sized tree.

E. citriodora—The Lemon-Odored Eucalypt. This tree combines with the many virtues of eucalypts the advantage of yielding from its leaves a large supply of volatile oil, of excellent lemon fragrance. Tree tested at Berkeley.

E. sideroxylon—Ironbark. Reaches one hundred feet or more; timber of great strength and hardness; prized for durability by wheelwrights, carpenters, ship and railroad builders, miners, and turners; considered the strongest Australian timber; proved in California.

E. diversicolor—The Karri. Of southwest Australia; a colossal tree; exceptionally four hundred feet high; timber excellent; for shady foliage of dense growth, one of the best for extended avenues; thrives well at Melbourne.

ELM FAMILY.

Ulmacæ.

They are chiefly grand and graceful trees of great expanse, and among the most useful timber, shade, and shelter trees of the north temperate zones of both old and new worlds, allied to the nettle and bread fruit; their heads rounded, and branches and twigs more or less arch urn-form; simple leaves saw-toothed, alternate sickle-pointed, roughish and unequal sided, set alternate in two rows on the sides of twigs; seeds roundish, wafer-winged, or membranous margined; one cherry like nettle tree.

Ulmus Americana—American White Elm. A Summer-green tree of marvelous majesty and extreme elegance; rises seventy-five to one hundred feet or more; four to eight feet diameter; the vast limbs in successive graceful curve or arching gothic symmetry, and fountain spray unrivaled; the pending branchlets of these sylvan curtains are smooth and not corky, graced with a two-rowed foliage, quite unequally subheart-form at base, and the top suddenly attenuated, with points incurve-hooked; flowers in fascicles; the circular winged fruit eye-lashed on the margin; this arching elm is fond of moist margins of rivers, but will grow in any soil; bears transplanting and pruning freely; timber light, tough, elastic, strong, and durable; growth rapid, and lasting age; thrives well in California from seeds, slips, etc. A national favorite for public and rural adornment.

U–s racemosa—Corky White Elm. Only varies from preceding in the somewhat corky twigs in youth, and with the buds downy, and fruit racemed; the wood is regarded finer grained and of tougher quality by wheelwrights and wood-workers.

U–s campestris—English (*Cork* and *Wych*) Elm. Of Europe, Asia, and Japan. Tree of enormous size, of great age, and valuable quality; is tough, hard, fine-grained, and very durable; next to the best in archery, and for keels, blocks, hubs and wheels, piles and pumps, gun carriages, gunwales, tools, etc., the bast of this and several elms as chair-bottoms.

U–s crassifolia—An Evergreen Elm of Texas and Mexico. The *U. parvifolia* is an Asiatic Evergreen Elm.

U–s Floridana—Florida Elm. Tree of forty feet.

U–s fulva—Slippery Elm. Of moderate size; rarely over two feet in diameter; leaves thicker and rougher, more bluntly toothed, the feather veins hairy, prominent beneath, apter to be branched towards the edge; the upper surface rough both ways; the seed broader and more perfectly circular; bark sweet, nutritious, and slippery; very valuable in innumerable ways; wood large-hearted, flesh-colored, most useful, and durable.

U–s alata (racemosa?)—Winged Elm or Wahoo. Chiefly of the South and West United States; thirty to forty feet; bud scales and branchlets nearly smooth; smaller branches mostly corky-winged; wood fine-grained, heavier, and stronger than the *White Elm.* Said not to be equal to the European (?), celebrated both for strength, durability, and beauty; exceedingly hard and strong for machinery, tackle-blocks, and farm implements.

U–s Mexicana—Mexican Elm. Tree sixty feet or eighty; a quick growing avenue tree.

U–s pedunculata. Of Middle Europe and Asia, for avenues.

U–s Wallachiana—Himalayan Elm. Three thousand to ten thousand feet altitude; grows up to seventy feet; a deciduous species.

PLANER-TREES.

Planera.

Trees allied to Elms; leaves smaller, flowers in axillary clusters, yet the rough nut-like fruit has the seed of Buckthorn; flourishes in rich lowlands or swamps; wood aromatic.

Planera Japonica—Japanese Planer-Tree. This is considered one of the best timber trees of Japan.

P-a aquatica.—Growing in sub-swamps and along wet banks of streams from Kentucky southward; nearly smooth; the small leaves oblong-egg-form; fruit stalked in the cup, beset with irregular projections.

P-a Richardi.—Between Black and Caspian Sea; trunk like a beach; lofty, richly tufted, rapid growth, shining foliage; no insect ever infests; wood of great value, extremely beautiful; heavy, hard, fine grain and polish; more durable than oak.

Hackberry, Sugarberry, or Nettle-Tree *(Celtis)*. These are chiefly large shrub trees, of strikingly neat and elegant appearance; the foliage is rich and abundant, but more emotional, though in general aspect like elms; fruit like bird-cherries, from the axils of leaves, the pulpy coat over the stone thin, in color brownish, or to purple and black; of sugary sweetness.

Celtis occidentalis—Nettle-Tree, Sugarberry, Hackberry. From a bush to a tree of fifty to eighty feet high and several feet in diameter, with varieties not sufficiently distinct for species; the wood is exceedingly close, fine, satin-grained, tough, and elastic; splits remarkably free, noted for its rapidity of growth, but exposed soon decays; used for baskets, bottoms of chairs, etc.

C-s Australis—Lotus-Tree. Of south Europe and north Africa; of longevity; to fifty feet high; available for avenues; berries edible; wood hard and dense—admirable for turning and for similar uses.

FAMILY MORACEÆ.

Of the Mulberry (*Morus*).

FIG FAMILY.

Middle-sized trees of milky sap, with rather large rounded, or heart-shaped and alternate leaves, simple or lobed; the texture tender. Flowers, male and female, on the same or separate trees, in tags from the forks or axils of the leaves, the fertile becoming compound cluster berried, like *Blackberries.* Their foliage, the favorite food of *Silkworms* (*e. g. Bombyx mori*). This division includes Banyan tree or vast Indian fig (*Ficus Indica*), also *F. religiosa*, *F. elastica* of California culture; India rubber tree.

Morus rubra.—Red Mulberry. Tree thirty to seventy feet high and one to two in diameter, with a thickly branched and rounded head, casting a deep shadow; fruit, dark purple or nearly black, of agreeable flavor, both fresh and in cookery. The wood is very hard, strong, and lasting, in demand as light timbers for ships, for treenails, and for posts, and railroad uses; mostly throughout United States on rich alluvial soils.

M-s nigra—Black Mulberry. Of South Russia and Persia; highly valuable for its pleasant refreshing fruit; cultivated from ancient times for ornament and for shade, its age marked by centuries; is very hardy, thrives

well in California, leaves also used for silkmoths; tree unisexual. *M. atropurpurea*, from Cochin-China, is allied to it; the cylindrical fruit-spike two inches long.

M–s alba—WHITE MULBERRY. Of China. A tree of low stature—as usually dwarfed—but abandoned attains to forty feet or so. The best food is of trees set in spaces of twelve by fifteen or twenty. With its manifold varieties yields the best food for silkworms, is of extremely easy culture from cuttings in sweet soil free from stagnant moisture. Being cultivated for the last four or five thousand years with the silk industry of Asia, like objects of similar rural care, very many varieties have arisen. Among these may be mentioned the *M. Indica*—macrophylla—*multicaulis*, *morettiana*, *chinensis*, *latifolia*, *Italica*, *Japonica*, *Byzantina*, *nervosa*, *pumila*, *tortuosa*, the Constantinople, *tartarica*, *pabularia*. Some have palatable fruits, as those of *Belloochistan* and Afghanistan. All of which are only choice forms of one and the same species.

As general remarks, it may be stated that the ROSE-LEAVED (Covennes) variety of *alba* is a free grower, yields largely of rather thick leaves, from which silk of a heavy and excellent quality is obtained; thrives best on rich dry slopes.

The *Bushy Indian* variety (*M. Indica* above) has beautiful flat long-pointed green leaves in abundance, but light; can cut three or four times or more a year; has fine aroma, and is greatly relished by all worms, though all may not thrive equally well upon it. This requires rich low bottoms; of amazing thrift at the shortest notice; fruit black.

The North Chinese (*Chinensis* above) has heart-shaped, flat, thickish, leaves of good quality. For use in the earliest stages *Cape* and *Morettiana* do; manilla varieties, *multicauli*, weeks earlier.

M. celtidifolia, of Mexico and Peru, at seven thousand feet; fruit edible. *M. insignis*, of New Granada, is a similar species.

Broussonetia papyrifera, called PAPER MULBERRY, from its resemblance; only noted because the bast makes very strong paper, and may be utilized as a textile fabric covered with linseed oil for a water-proof; is also very light; will thrive well here; is an ornamental shrub or small tree; is of no value for either its leaves or wood. From the isles of the Pacific, China, and Japan; makes fine crates for oranges, etc. If for subordinate uses it is best cultivated in the copse, like osiers.

Maclura aurantiaca—OSAGE ORANGE. This is a most beautiful, low, round-headed tree, as grown in the south Atlantic, United States, and west of the Mississippi; has the charm and splendor of an orange tree, and, as we have seen it, of equal size, and, if possible, greater symmetry; grows, however, to sixty feet. In California, hitherto, only used as a Summer-green hedge. The wood satiny-yellowish, very elastic, strong, and durable, polishes like steel, and is nearly as elastic. The best thills, tongues, and felloes of carriages, and bows for archery are made of it; hence known as "Bow de arc" tree, or bowwood. Silkworms may be fed on it, but it proves inferior to the mulberry; easily propagated by seed, by layers, and by cuttings from the roots. It is surprising that such valuable timber, for so many purposes, is not more cultivated. Fruit large as an orange, finely tesselated surface, like a pineapple, of light lemon yellow-greenish color; leaves, like a white mulberry. The horrent thorns stand guard against its use, if the silk and worm were not impoverished thereby.

Maclura tinctoria—FUSTIC or YELLOW–WOOD. Yields a yellow dye and pleasant fruit; the wood of great value; a tree of the West Indies. All the *Morads* are trees of rapid growth and almost imperishable wood; mummy-cases of many thousands of years supposed to be made of them; the bark

of all abound in fine fibers like the best flax, and hence, valuable for cordage and paper making, etc.

Laurelia aromatica—AROMATIC PLUME-NUTMEG-TREE. A colossal tree of Southern Chili; in Valdivia the principal one used for flooring; the timber never bored by insects; well adapted also to exposure to the weather. (Dr. Philippi in Baron F. Von Mueller's Catalogue of "Forest Culture.") Noted for its close alliance to mulberries.

Brachychiton acerifolium—MAPLE-LEAFED FLAME TREE. An evergreen shade tree with magnificent trusses of crimson blossoms, like *B. pulneum;* suited to promenade lines, and yields a kind of tragacanth gum.

CINNAMON FAMILY.

LAURELS (the LAURACEÆ) *Laurus.*

Are generally trees of considerable size; somewhat distinguished by mostly alternate leaves; flowers clustered, inconspicuous, or without petals; stamens, about nine (six outer and three inner, their anthers for the most part valved inwards); ovule, pendulous, never erect; stone-fruited, on a thickened base; aromatic, abounding in fat, or both fixed and volatile oils with camphor; in quality they closely resemble Nutmegs. Extensive order. Trees of great beauty and eminent use; only a few of little note.

Laurus nobilis—The NOBLE LAUREL of Asia Minor. Leaves in great request for various condiments, confectionery, etc.; will grow in California. Mr. Klee, gardener of State University, has it flourishing at Berkeley. The peculiar aroma of these Bay leaves cannot be replaced, unless perhaps by *Lindera benzoin*, *Persea Teneriffæ*, of Mad'n, Azores, and Canary Islands, etc.; a magnificent tree, mahogany-like wood, hard, and beautiful for fine furniture and turnery. One of the most hardy trees of this large order, *Laurinæ.*

L–s benzoin—SPICE BUSH, WILD ALLSPICE, FEVER BUSH, etc., also as *Benzoin odoriferum.* A shrub eight to ten feet; in damp woods; leaves, obovate, pale beneath, two to four inches long and one to two wide and shortly sharpened; fruit, small as bird cherries, dark purple; smooth branches; brittle; spicy odor and pungent flavor. Common in United States.

Benzoin melissafolium—BALM-LEAF BENZOIN. Lowlands of Virginia southward; branches, soft and hairy; the oblong leaves blunt or heart-form at base and downy beneath; flowers of the umbels few.

L–s sassafras (SASSAFRAS *officinale*)—SASSAFRAS. Tree, forty to fifty feet high by one half to three in diameter; often only a bush ten to fifteen feet high; frequent in woods and fence rows; in age horizontally branching, broadly flat topped; the large leaves entire or variously lobed, of soft, yellow-green luxuriance; fruit, pale ultramarine blue; bark, an aromatic stimulant of highly esteemed medical virtue; timber, reputed secure preventive of vermin and insect pests in cabinets, etc.; is light, stiff, and durable; leaves and pith of the twigs abound in a delicate mucilage, useful for various purposes. The fragrant and agreeably spicy taste of the bark, especially of the root, is used as a tea, and for flavoring rural Spring beers. Singularly ornamental.

Umbellularia Californica—CALIFORNIA LAUREL, BAY TREE, etc. As coast tree of the Pacific, fifty to one hundred feet or more, two to eight feet in diameter, timber very tough, elastic, and takes fine polish; a remarkably beautiful evergreen, of erect growth while young, in age becoming arched and pendulous; in rich, moderately moist localities, of free growth; the

interior and alpine forms more shrubby: kernels yield tallow, leaves used as spice.

Cinnamomum Camphora—CAMPHOR TREE. Of China and Japan. A beautiful yellowish-green ever vernal tree, of rapid growth on the coast; attains to forty feet; uninjured by frosts. beautiful for rural adornment: the wood and all parts abound with camphor. hence not infested with insects. Mr. Klee, gardener of the Berkeley University grounds, will take pleasure in pointing the enterprising inquirer to a finely flourishing tree in the open groves there.

Camphora officinarum—CHINESE CAMPHOR TREE. *Oreodaphne opifera*, of South America: yields a camphor product, and very many others.

Tetranthera (umbellularia) *Roxburgii*.—Yields fatty matter similar to our native BAY TREE.

T–a calophylla—The JAVA TALLOW TREE *(cyclodaphne sebifera B.)* From the kernels of the berries a tallow-like fat is pressed for making candles; the yield is said to be large.

As the laurels and camphoraceous trees consist of between fifty and a hundred genera. besides a vast number of species and varieties, suffice to say in a general way they exhale this camphor-laden sphere repellant alike to noisome insect pest—as most mixed woods are wont in their degree—sentineled over the tender. non-resistant fruit tree, but are also salutary natural guards lest the "plague come nigh thy dwelling."

Cinnamomum cassia—SOUTH CHINA CINNAMON TREE. The Chinese cinnamon or "cassia lignea" is from *C. obtusifolium, C. panciflorum. and C. tamala*, up to six thousand or eight thousand feet; will grow in California; the root also yields camphor.

LINDEN FAMILY.

Tiliaceæ.

This forestal family includes nearly forty genera, chiefly large umbrageous trees, with tough fibers of the inner bark, and light soft wood, devoted to many important uses. In general the prevailing foliage is heart-shaped, but the most distinguishing feature is the main flower stem of the cyme, cluster. being kneed or bent where it coheres with the mid-rib of a thin-narrow, leaf-like bract. and thence winged to the base, the upper half free.

Tilia Americana—AMERICAN LINDEN, BASSWOOD. A tall rather conic tree, of striking regularity of its numerous horizontal branches, with ample obliquely heart-form foliage, notable as affording a deep mass of dense shade, turning to a gay lemon yellow in Autumn; flowers numerous, creamy whitish, very fragrant, and the honey bearing lure of bees; tiny fruit size of a pea, and bony nut like, with a single stone. The wood is soft, whitish, of fine close grain. coherent and pliable, in request for coaches. cabinet. and inner carpenter work, also for hollow wares, carvers, and affords the very best coal for gunpowder: and being highly ornamental. is a favorite rural shade and shelter tree. Propagated by seed, or multiplied more rapidly by cutting an old tree close to the ground and covering the stump with earth. they forthwith shoot up as elms and the like, with great vigor, and the suckers have soon rooted and ready to transplant.

T–a Argentea—SILVER LIME TREE. Of Southeast Europe. The wood of this is not attacked by boring insects. The flowers deliciously fragrant, and yield on distillation a precious oil.

T–a Europea. A favorite round topped rural tree of Europe, hence

European Linden; justly admired for its venerable antiquity, fine form, fragrance of flower, and beauty of foliage; the broad blade on long and slender leaf stems like the aspen, which gives ease, and as it were, living grace of motion is heart-form, yet there is coquettish obliquity enough to vary the formal, with considerable extenuation of the tip; as age impends, the ponderous boughs take on a curtain-fall tendency of sober grace and becoming dignity; then, full oft the central head is wont to become twiggy, thickened—is hence the high sylvan home of the song bird, and secure retreat against birds of rapine and beasts of prey.

Lindens and basst-woods (ancient *tiel trees*) are celebrated for light, soft, white wood, most even grain, and best ordinary wood for the carver and musical sounding boards, not liable to split.

WILLOW-WORTS.

Salicaceæ.

Comprise two genera, or Poplars and Willows. Both have male flowers on *different trees*, while nearly all the other *Amentifers*, or catkin-bearers, are from different buds on the *same tree*. The seed chambers of both are leathery, one celled, two to four valved, small, and the minute cottony seeds, with long silky hairs, from the base.

Poplars (people's trees) consist of twenty or more kinds. These cottonwoods, like the willows, usually grow by little watercourses, or by the banks of larger streams; their male flowers in long catkins—these are the pretty tagtail tassels that grace the twigs of Spring; their leaf stems mostly flattened laterally, or expanded vertically, near the broad blade, hence their tremulous or rocking motion; stamens apt to be very numerous.

Populus grandidentata—Big Tooth-Leafed Poplar. Tree forty to fifty feet high, by two through; leaves nearly circular, dimensions two to four inches; noted for the few large and unequally-toothed margin, and for the fertile flowers being inconspicuous; both tags and fruit very small; the two to four-inch leaf stalk is flattened sidewise near the base of the blade; buds conical; found native in the mountains of Carolina and Georgia of the United States, and North; wood soft, formerly for "chip hats," before the palm-leaf Summer hat era.

P–s angulata—Angled Cottonwood. A large tree, fifty to eighty feet, by two to three in diameter; young branches sharply angled; leaves somewhat heart-shaped, point attenuated, margin hook-toothed; the young leaves of sprouts very large (seven inches or so), and strongly heart-like. Seacoasts of southeast United States, along rivers; (the *nigra* of *Walter*, and *angulosa* of Michaux).

P–s heterophylla—Variable, or Downy-Leafed Poplar. Tree sixty to eighty feet, by two to three; branchlets not angled; male flowers of fifteen to twenty stamens; leaf stem nearly round; of southeast United States, middle and upper Carolina, and Georgia.

P–s Fremonti—Fremont's Poplar. A large tree, fifty to one hundred feet high; by banks of streams and rich bottoms; from the Pacific of Upper Sacramento to Nevada, Utah, Colorado Valley, and Southern California to Rio Grande. Leaves, kidney-form, with broad sharp point, slightly bayed at base, its leaf-stalk latterly flattened, few coarse teeth on the margin; scales of long tags, with sixty or more stamens; fruit-pods, three-valved, very thick and leathery; seeds, white. The Southern California variety, *Wislizeni*, has the leaves a little wedged at base; fruit pods a little angled, and often valved on long, rather slender, fruit stemlets. As the

logs are four to six feet through, the lumber is in the market for lighter protected uses.

P–s monilifera—Neck–Lace Poplar. A tree of eighty feet, the young branches a little angled; leaves, heart-shaped or blunt at the base, taper-pointed, long leaf-stem, a little compressed; scales of the male flowers torn-fringed but not hairy; this is the *Bead-fruited Cottonwood* (*P. Canadensis* of Michaux, and *levigata* of Wild.), the best Cottonwood for speedy timber.

P–s trichocarpa—Pacific Hairy–Pod Poplar. A tree sixty to one hundred feet high by three to six through, branches somewhat angular, and, like the buds, varnished-viscid, heart-trianguloid leaves, on rounded stem, variable; often broad egg-shaped of two to four inches dimensions. Perhaps best popularly distinguished by being *rusty underneath*—tiny pods, densely soft, hairy, and three to four-valved. *P. Balsamifera* variety, Hook variety, *Californica*, Watson, Santa Clara R., California to Oregon, Washington Territory, British Columbia, etc. Being sparsely distributed, little as marketable lumber is used for furniture, staves, and for butter boxes, etc.

Poplars, like Willows, should line our rills and runs, gullies and deeper gulches, at the risk of seedy nuisance, for the sake of staving hideous wash-outs and intercepting field and forest fires. White P., *P. tremula*, E. Aspen, and native *tremuloides*, N. A. Aspen, and *P. Nigra* Black, are all good.

Willows are trees, shrubs, or undershrubs, mostly near water; twigs rounded, buds covered with only one scale; leaves usually long, relatively narrow and feather-veined.

Salix Babylonica—Weeping Willow. From west Asia to as far as Japan. For ornament, and for consolidating river banks.

S–x sessilifolia—California Gray Willow. The narrow silvery leaves sitting close down upon the twigs; an ornamental foreground bush, or sometimes tree, to ten inches or more in diameter; the soft, hoary pubescence particularly pleasing; the variety *Hindsiana* of finest foliage; along the coast range of the Pacific, from Santa Rosa to Ukiah; also Sacramento valley.

S–x caprea—The British Sallow, Palm, or Hedge Willow. Among the earliest willows—in blossom so soon as Palm Sunday; wood useful for handles of sundry implements, and bark for tanning.

S–x cordata—Heart–Leaf Willow. One of United States osiers, the leaves oblong, lance-pointed, heart-shaped only at base, with sharp teeth, smooth above, paler beneath; stipuled appendages broad and leaf-stem conspicuously winged, like the feet of Mercury; along inundated banks and low meadows; of several varieties; common variety *rigida*, larger, six to fifteen feet, leaves four to eight inches long, fruiting catkins a half less, and leafy at base; seed vessels smooth and set high on thready stems; male flowers of only two stamens. In California sub-alpine.

S–x viminalis—Basket Ozier. From Europe and north Asia; one of the best for basket work; suited to rich, moist meadows; when cut down shoots up sprouts ten to twelve feet; fine for withe bands or hoops and wicker work; grows to thirty feet; leaves long, line-like, and taper-pointed, white-satiny beneath. Smith's variety is the best. A similar native, tough-twigged willow, *S. Austinæ*, of Sierra and Mono valleys, favorite of our Indian basket workers.

S–x fragilis—Brittle or Crack–Willow. A large European tree to ninety feet, contains more tannin than oak, and more salacin (a substitute for quinine) than most other willows, besides, the timber is light, tough, and elastic; var. *Russelliana* is cultivated for basket work.

S–x lucida—Shining Willow. A beautiful native *osier*, a shrub or small

bushy tree; leaves usually narrowly lanced, shining on both sides; stamens or male-threads mostly five; common along overflowed banks of streams.

S–x rubra—RED WILLOW. Of Europe, Western Asia, and Northern Africa; chosen for osier beds, as cut down it shoots eight feet or more in a single season.

S–x triandra L. (S. amygdalina L.) ALMOND WILLOW. In Europe and Asia; for white basket work, being both pliant, tough, and durable; tree thirty feet, shoots nine feet or more.

S–x daphnoides—DAPHNE or LEATHERWOOD–LIKE WILLOW. Middle Europe and Northern Asia; tree of great rapidity of growth.

S–x lanceolata—LANCE–LEAF WILLOW. One of the basket willows of Britain.

S–x purpurea—PURPLE WILLOW, of wide range in Europe and Western Asia; one of the osiers. There are between one and two hundred species of willows to select from, besides a vast number of varieties; all of easy culture from cuttings. The GOLDEN OSIER (*S. vitelina*) is one of these varieties, viz.: from *S. alba;* the shoots used for hoops and wicker work. As an ornamental tree the terminal branch twigs pend gracefully and are of greenish golden hue, or smooth and yellow.

Combretum butyraceum—BUTTER TREE. Of Southeast Africa. The butter fat of the fruit has a delicate, spicy flavor; would flourish in the hottest sheltered parts of Southern California.

Pittisporum undulatum. A common tree of Illiwarra, New South Wales, near Sidney; suitable for wood engraving.

Diospyros ebeneus—EBONY. Up to five thousand in Ceylon; furnishes the best ebony wood. Most other kinds could be introduced into California. *D. melanoxylon*, *D. kaki*, *D. Ebenaster*, *mabolo*, *tormentosa*, *roylei*, for their black timber, if not fruit. The "KAU APPLE" of South Africa another.

D–s Lotus—DATE PLUM. From North China to Caucasus; like black cherries; wood like *D. chloroxylon*. Often known as *Green Ebony*, but not to be confounded with *Excœcaria*, *Nectandra*, and *Jacaranda*.

D–s Virginiana—PERSIMMON, or native *Date Plum.* A conic deciduous tree, thirty to forty feet high, a foot or so in diameter. Timber very tough, lasting, and elastic; fruit size of a plum; golden, ruddy, honied pulp, soft texture, and glaucous hue; delicious after late frosts. Improved by culture.

All the EBONY FAMILY have wood that finishes finely, and closely resembles the Satinwood of India.

Maba geminata is one of the Ebony trees of Queensland; black towards the heart, and bright red towards the bark; close-grained, hard, heavy, elastic, and tough; takes high polish, and is fine for veneers.

M. fasciculosa, the outer wood white and pink; good substitutes for ebony.

Embothrium coccineum—"NOTRA or CIRUELILLO" of Chili; from thence to south, and of Magellan. A tree of exquisite beauty; seldom over thirty feet high; wood utilized for furniture. One also equally gorgeous of the Peruvian Andes, the *E. emarginatum.* Also *E. Wickhami* of North Queensland, the allied *Stenocarpus sinuatus*—Eastern Australian.

Eucryphia cordifolio—Muermo, or Ulmo, of Chili. Magnificent evergreen tree over one hundred by six feet diameter; flowers favorite of bees. In Chili the wood preferred for oars and rudders.

Eugenia cordifolia—HEART–LEAF MYRTLEBLOOM. Ceylon, up to three thousand; fruit an inch diameter. *E. maboides*, seven thousand; fruit size of a cherry. *E. Hallii*, Quito; fruit of large size.

E–a maboides—Ceylon, up to seven thousand elevation; fruit size of a small cherry.

E–a malaccensis—The large Rose Apple of India. Although tropical may suit some southern forests; leaves a foot long; large fruit of rose odor, wholesome and agreeable taste.

E–a myrtifolia—East Australia. Handsome bush with palatable fruit.

Fraxinus Oregana—Oregon Ash. California and Oregon; tree from fifty to one hundred feet; timber similar to white ash of the East; damp, stiff, rich soils of ravines, swamp, and river margins; in high request.

F–s Chinensis—China Ash. On which a peculiar wax is produced by *coccus pela*; forty thousand pounds annually exported. *F–s Americana*—White Ash, *F. pubescens*—Red Ash, *F–s viridis*—the Green Ash, *F. sambucifolia*—Black, or Swamp Ash, *F. quadrangulata*—the Blue Ash, *F. platycarpa*—Carolina, or Water Ash, are all of inestimable value. In the ornamental ornus section *F. dipetala* and *F. ornus* are the best for promenade trees; well known for use and beauty. *F. excelsior* not only yields manna but like most, the bark is medicinal; being allied to the olive would doubtless make good stock to graft the olive and the *Fringe Tree*, and the lilac upon, all febrifuges of celebrity apart from combined beauty of ornament unequaled!

Magnolias are mostly trees of noble aspect, striking foliage, and large, fragrant flowers, three shedding sepals of the cup; petals six to twelve in concentric series; cone-like fruit, from which the ripe seeds hang by fleshy threads, etc. Usual floral season from April to August.

Magnolia grandiflora—Great Laurel Magnolia. A magnificent evergreen tree, sixty to eighty feet by two to five; clear, clean shaft and semi-elliptical or pyramidal head, clad in large, brilliant white flowers that tip the young branches: they brown with the slightest bruise or scratch; hence, the courteous are wont to write their "Rosalind" upon the exquisitely fragrant and delicate petals; in California, flowers more or less the whole year round; thrives best on rich light soil: native of the South Atlantic and Gulf, United States.

M–a glauca—Little Sea-Green Laurel Magnolia. This delightful little tree is a hardy favorite, the most fragrant of all the species, fifteen to thirty feet high—rarely forty to sixty—symmetrically conic and densely branched, bark whitish, evergreen leaves elliptical, about three by two inches, showing green above and softly gray-greenish, or even satiny-whitish beneath; flowers white, petals nine to twelve, two to three or four inches across; aroma strong, may be scented from afar. Delights in swamps, thrives by springs and streams, and will grow well on moderately dry soils, but then the flowers more fugacious. Also known as *Swamp Sassafras* and *Beaver–Tree.*

M–a acuminata—Cucumber Magnolia. A tree of tropical verdure of the mountains of South United States and throughout the Middle, and valleys of the West, where it grows to sixty or ninety feet high, clean trunk, two to four in diameter. Leaves broad-oval, lance attenuate-pointed, soft silky beneath, the flower leaves egg-form, gray yellowish-greenish hue, or tinged with blueing; cylindrical fruit, two to three inches long, somewhat like a cucumber: hence, "Cucumber–Tree." Found in rich forests from West New York and Pennsylvania to Ohio and South.

M–a macrophylla—Great–Leaf Magnolia. A small tree, thirty to forty feet high, often much less; branches fragile and weak, sheltered by other forest trees; bark pale Russia-leather to white: leaves very large, to nearly three feet long by ten inches wide, ob-egg form, sharp pointed, but narrowing back to a heart base; pale-greenish beneath, or silky and silvery.

Flower petals white, purple tinged inside at base; four to five inches long, of egg form; fragrant. Mountains of North Carolina, Kentucky, and Tennessee. Flowers eight to ten inches broad. In rich sheltered woodlands.

M–a umbrella—UMBRELLA TREE. A small Summer-green tree, twenty to thirty-five feet high, with a few irregular branches, but simple, of fifteen to twenty feet. The body is weak, rarely over three inches in diameter. Leaves very large, from one and a half to two feet long and six to ten inches broad, crowded at the summit all around like an umbrella. Outline similar to the above. Throughout the far southeastern United States. Flowers seven to eight inches broad. In rich half-shady woods.

M–a cordata—HEART–LEAF MAGNOLIA. Tree forty to fifty feet, usually twenty-four to forty. Leaves four to six inches, by three to five; flower cup small; petals oblong-lanced, yellowish, faintly streaked with red, three inches long. Carolina and Georgia.

M–a Yulan. Of China; fifty feet.

M–a Campbelli. Of the Himalayas; one hundred and fifty feet high. Flowers nearly a foot across.

Drimys Winteri—WINTER'S BARK (Chilian *Canelo*—BOIGHE of the natives). A tree of sixty feet; wood never attacked by insects.

Liriodendron tulipifera—TULIP TREE. A most beautiful tree; over one hundred and fifty feet high, eight to nine in diameter; colossal columnar. Soft, smooth foliage like some maples, as if abruptly cut off at the end. Flowers like tulips, two inches or so broad, greenish-yellow streaked with orange. Of the richest bottom lands of the United States. Soft timber, very valuable as a substitute for white pine in carpentery, joinery, outdoor, and inside work for coach panels, as it never nail-splits; also, bowls and hollowware. Is light, works well to the curve of stairways, and is strong; makes fine cylinders and wheels for mechanics, or post and rail of rural use. These magnolias are magnificent trees of tropical verdure. To beauty they add balm, giving grandeur and glory to forest and glen.

Leucadendron argenteum.—SILVER TREE. South Africa. For splendor—the Protead *Stenocarpus sinuosus*, the most brilliant crimson of all the tribe; *Metrosideros florida*, the Scarlet Ratas of New Zealand; *M. robusta*, eighty feet high; *M. tomentosa*, forty feet. On the coast where the native *Rhododendron* flourishes, *R. Falconeri*, fifty feet. The great *Melaleuca leucadendron* or CAJUPUT TREE of Asia grows to one hundred feet (true cajuput oil tree).

Liquidamber styraciflua.—SWEET GUM TREE (*American Storax*). Colossal stem six to ten feet diameter, and one hundred feet or more; wood fine-grained, balsamic juice; hardens to resin of benzoin odor.

L–r altingia.—STORAX TREE. Of Red Sea, India, and *New Guinea*; at three thousand feet; one hundred and fifty to two hundred feet high; wood heavy, very close-grained, and extremely fragrant; yields the *liquid storax.*

Ilex aquifolium.—EUROPEAN HOLLY. An ornamental evergreen; to sixty feet. Although thriving here hollies are of slow growth.

I–x opaca.—AMERICAN HOLLY. Symmetrically conic tree thirty to forty feet high; prickly-margined leaves smooth and shining; berries lighter red than the English, and to our eye, a handsomer tree. The wood of both close satiny white; sap almost ivory hard; takes a fine polish; used by engravers, and for inlaid cabinet work, for turnery, and by screw and whip-makers, etc. United States, east and south.

Ficus columnaris—BANYAN TREE of Lord Howe's Island. Not tropical; one of the most magnificent productions of the whole vegetable kingdom. As it were, a vast sylvan temple, the pillared dome of dark evergreen foliage resting on stems so alike none can say whence the banyan cometh nor

whither it goeth. In warm and sheltered humid tracts of Southern California coast, or some choice island nook, this almost boundless bower might become another world's wonder. Whether it yields caoutchouc, like most figs, is still untested. But as to its being one of the grandest ornaments in the world no one will question.

F–s cunninghami — CUNNINGHAM'S FIG. East Queensland. A tree of monstrous growth, the large spreading branches sending down rooting stems like the banyan: body twelve feet or more through; the sweep of root base forming wall-like abutments: some extend twenty feet from the tree: in the large crevices of the trunk several could conceal themselves; yields caoutchouc.

F–s colossea. COLOSSAL FIG is still more gigantic, though not so hardy.

F–s elastica—INDIA RUBBER TREE. Upper India. Looks thrifty in California; a large tree; milky sap concretes to caoutchouc and also *F–s laccifera* or MILKY FIG from Silhet is another, and that this and *elastica* yield most in a ferruginous clay soil on a rocky substratum; both bear dryness, but like shade in youth. Out of six hundred species, and some from cool mountain regions, it would be strange if some would not tolerate our clime well, although most are tenderly promising.

F–s rubiginosa. Of New South Wales, is one of the hardiest; makes an excellent evergreen shade.

F–s carica—FIG. In its native state is small and of inferior quality. A wonderfully reproductive, prolific, and profitable tree, even bearing the first year from cuttings to half a century or more, and not one but several crops in a season—in its prime, in the short space of five years. Planting a less number of trees than the fingers of one's hand would suffice for the ordinary support of a family for a lifetime in this land of the olive, vine, and fig tree, with none to make afraid ! Is not this neglect then a marvel of prodigality, if devoting a few months—say the brief time of penning this note—with future care and due providence; yet so few of us manifest forethought and enterprise enough, each citizen morally or religiously to plant some noble tree of honor, of fruitful renown, and of profit or general use, a testimonial to the ages following! Granted such a boon, who could picture our beautiful and bountiful Pacific of the future? Japan of the setting sun!

As an export article, only the white is deemed available. At La Paz, a variety, the first crop blue or black, the second white—both delicious and highly valued; also, some plantations in Lower California are already noted for the excellence of their figs. The black or purple mission fig is a fine fresh table fig, of more general thrift. Prof. G. Eisen, of Fresno, issued a pamphlet on "Fig Culture and Curing," of great value, in which he says the best conditions suitable for figs are: *First*—A moist soil of light sandy-loam before beginning to ripen, but later drier, with perfect drainage at all times. *Second*—Sufficient heat, sun, and air, to insure sweetness. *Third*—Absence of frost, or a lower temperature than 18° Fahr.; albeit, they can bear 12° if tolerably dormant. *Fourth*—No heavy rains while ripening, and alike shielded from heavy dews in drying.

In the most favored Smyrna districts, Summer seldom exceeds 90° to 100° Fahr. in the shade. 130° to 140° in the sun; freezing in Winter is seldom more than half a dozen degrees. A heavier frost is not considered injurious, or in any way influencing the quality of the fig crop.

Where the best of *Figs* have been cultivated as a staple crop for thousands of years—perhaps even the people of the Pacific might learn something—in any event it is well to know that in the Aidin district of Asia Minor fig trees are always set two in the same hole (spaced twenty-five to

thirty feet distant, according to soil, the poorer the better, in March), put a foot apart, then joined at the top, and here made to cross each other like the letter X, a few inches above the ground. At this junction they are tied to each other, and to a stake, to keep steady; both trees allowed to grow and develop into one tree, the stems being wound one around the other, like a twining vine around a pole; is the object to prevent self-fertilization, and so, as it were, hybridize by the pollen of another tree, thus in connubial proximity? These cuttings, taken at different times of the year, although from the same parent tree, have more male flowers in the first crop than later on. Figs, like nut-producing trees, must be sparingly, if at all, pruned. Of the six hundred varieties of figs it is probable many would flourish finely in California. Of these the Australian *F. colossea*, *F. altissima*, and *F. Australis*, are promising, besides the Egyptian *F. sycamorus*, of whose imperishable wood ancient mummy cases are presumed to have been made, and the Brazilian *F. anthelmintica*.

Hernandia Sonora—THE DEPILATORY TREE. A Daphnad, or allied to moosewood. The leaves chewed and applied to any hairy part, "it destroys the hair without pain."

Dirca occidentalis—WESTERN MOOSE OR LEATHER WOOD of California. Tremendously tough bark, and extraordinarily light, white wood—like Mezereon bark—acrid, and the bark of the root even more so; blistering; medicinal; would make a superior quality of paper, etc.

Pterocarpus Indicus—LINGO. China and India. A tree of considerable dimensions, famed for its flame-red wood; furnishes a kind of dragon-blood resin. Leguminous.

P–s marsupium—RED SANDAL-WOOD. Sheltered and free from frosts would thrive here; yields the best kino. Mountains of India.

Liquidamber orientalis—ORIENTAL LIQUID-AMBER. All these storax species are tall trees yielding balsam. This, from Asia Minor, furnishes a vanilla-scented liquid storax, used as a perfume to scent tobacco in cigars, and to keep moths from clothing, etc.; abounds in Cumarin.

L–r styraciflua—SWEET GUM TREE. A large and beautiful tree of United States, seventy to eighty feet high by two to four; alternate leaves roundish, palm-form, the starry radiating lobes attenuate-pointed and toothed, similar to the *Vine Maple*, but fewer divisions; when bruised or torn very fragrant; tree exudes a kind of gum-resin storax, pleasantly aromatic; wood soft, fine-grained, and suited for interior carpenter and cabinet work, bowls, and other woodenwares; thrives best in rich alluvial bottoms and river swamps.

Loptospermum lævigatum—SANDSTAY SHRUB, or tree. One of the most effectual of all for arresting the progress of drift-sand in a dry clime like ours; seed scattered in Autumnal first rains on the sand and loosely covering with boughs *pro tem.*

Ligustrum Japonicum—JAPAN PRIVET. A sub-evergreen shrub; grows as readily from cuttings as the common *European Privet*, and a like valuable hedge plant.

Lippia citriodora—CITRON-SCENTED LIPPIA. An evergreen shrub of Peru, Chili, and Brazil; yields scented oil; thrives in California.

Although MUSADS—*Plantains* and *Bananas*—are tropical natives, still they will thrive in Japan, Florida, and South Carolina. Some will even *grow* out of doors in the cold clime of the vicinity of San Francisco with slight protection from the northwest. As foliage displays, their gigantic leaves are among the most striking objects of the vegetable kingdom, and for food fruits unrivaled. Some of the finest muslins of India are made of

their fibers *(M. textiles)*. Young shoots eaten as a delicacy; also, juice of fruit and stem as medicine, dye, and essential oils, etc.

Musa Cavendishii—Lambert; (the *M. regia*—Rumph., and *M. Chinensis*—Sweet—CHINESE BANANA. A dwarf of five or six feet, of robust habit, fitted for exposed localities—reason why so extensively cultivated in the South Sea Islands; yields profusely, two to three hundred fruits in a single spike, and the flavor excellent—greatly improved where it is the most difficult to fruit them at all; this, as also *M. sapientum* and *M. paradisiaca*, ripen their fruit in Madeira and Florida, and a dwarf variety in Mexico, where it is often killed down by frosts, but rallies and comes again; the best with fruit of only the size of a lemon, of such exquisite flavor, and with local demand so great, it never reaches the export market, but commands an almost fabulous price at home.

M. ensete—BRUCE'S BANANA. Mountains of Africa. This magnificent plant attains to thirty feet; leaves twenty feet long by three wide—nearly the largest in the world; but few compound leaves of palms are larger. The inner part of the stem and young spike can be boiled and eaten as a table esculent, but the fruit is pulpless, although the seeds are eaten. As it produces no suckers, requires several years to come into flower and fruit, when it dies off like the sago palm, etc., without reproduction from the root.

M. Livingstoniana. From the same mountains of Safola in Africa; probably need no protection; similar to *ensete*; seeds smaller; found also in Mozambique and Niger regions.

M. paradisiaca. The ordinary grand Plantain or "Pisang," India; among the most prolific of all plants, requiring the least care in climes suited to its growth; stem not spotted; floral or bract-leaves purple inside. In this, the foregoing and the following, suckers are renewed annually from the root to replace the fruit-bearing stem. The fruit of this species is chiefly prepared by cooking; it is thought the varieties have sprung from the wild state of *M. sapientum*. They require a rich and humid soil. Plantain meal is simply the dried pulp ground; palatable, digestible, and nourishing.

M. sapientum—Common "BANANA" or SWEET PLANTAIN. India. One of the most important, delicious, and nutritious fruits; stem spotted; bracts green inside; the leaves, particularly the stalks and the stems of this and other species of *Musa*, can be utilized for yielding a fiber similar to manilla hemp. The golden fruit is usually eaten fresh and unprepared. Of these there are unnumbered varieties. Sometimes in tropical climes one hundred pounds of fruit is obtained annually from a single plant. At Carcas, where the temperature is seldom much above or below 60° F., they are loaded with fruits of more than a foot in length. But this uniformity is possible under the tropics only at about five thousand feet. Proximate success can only be obtained here in favorite sheltered spots. *M. simiarum* far excels in delicacy, and sometimes attains a length of two feet.

M–a troglodytarum L. *(M. uranoscopos*, Rumph.) India, apparently indigenous (?) in the Fiji and other islands of the Pacific. The fruit stalk of this stands upright; edible fruits small reddish or orange. Chinese *M. coccinea*, an ornamental dwarf, has the fruit-spike straight.

PALMS.—Plants of lofty grandeur, the serene crowning glory of the vegetable kingdom; usually of simple columnar stem, with a wonderful magnificence of plaited fan or pen-feathered foliage, not jointed, and flowers well on to the million, fruits to eight thousand even on a single individual. The family combines a perfect world of uses, yet scientifically the most simple; *e. g.*, thick, fleshy, six-parted flowers in spathes; minute embryo remote

from hilum, imbedded in albumen. Of these there are thousands of species of almost every form and habit, and it was thought by Humboldt that there must be an incredible number still to be discovered. They give the most complete tropical aspect to the landscape, and none are more worthy of encouragement than the natives.

Washingtonia filifera—Wendland—WASHINGTON PALM. This California desert palm, under culture by the early Franciscan padres, from the south-eastern part of the State, is over sixty feet high, and three feet or more through, with forty feet of clean naked shaft; of this the upper third is fan foliaged, edges lined with bleached fibrous threads, hence the specific name *filifera*, or thread-bearing, the large channeled leaf stalks armed on the edges with hooked horny spines; flowers in June; fruits in September; the fruit branch shooting out beneath the foliaged crown, bends downward ten or twelve feet long, laden with a wealth of clustered dark, skinny, bony berries, about the size of small peas, edible when pounded into coarse flour. Furnishes durable posts, everlasting piles, hat and thatch material, etc. The best specimen of this is seen at Los Angelos in the orchard of Señor J. H. Ramirez, planted about forty years or so ago. They require rather rich moist footing in warm and sheltered locality to thrive well.

Chamærops palmetto—TALL PALMETTO. Of South Atlantic United States, near salt water, preferring a rich damp soil; a palm tree forty to fifty feet high, by one to two feet diameter; the long leaves, five to six feet long, only at the very summit; a tree of the utmost value for submarine and naval structures, for it is probably, in this family only, of all native forest trees, not attacked by the *teredo navalis* or similar marine worms; it seems also absolutely imperishable in salt water; for posts and pickets it never splinters, closing over the ball, unharming and unharmed, and for sea and tide water structures is of incalculable value. The leaves can be utilized for hats, baskets, mats, and many more economical purposes. The great sole terminal bud is deemed a most delicious vegetable luxury, if one can be found who would wantonly kill so noble an object for such a purpose. Forests of these could be profitably cultivated apart from the landscape charm.

C. martiana. Of Nepaul; fifty feet; a noble object.

C. Richieana. Of Afghanistan; has proved hardy even in England.

We have some minor Dwarf Native Palms, as *pumila*, *serrulata*, *hystrix*, etc., but the DWARF PALMETTOS are mostly for ornament; the deep-tinted verdancy of one of these humbler fan-palms is very popular for limited lawns—*C. hystrix* or BLUE PALMETTO. To all intents and purposes stemless, it radiates from a terrestrial crown frond-like leaf-stalks, fan-tipped, three to five inches in length; but those most familiar to the citizen have lost some of their sheltered jungle and wild woodland magic spell—seared and fretted in the public thoroughfares.

C–s excelsa. South China; very desirable, though not tall, as the name implies.

C–s Fortunei—CHUSAN PALM. Twelve feet; leaves for palm-leaf hats; endures frost.

Livistonia Chinensis. A very decorative FAN-PALM of South China and Japan; hardy in most parts of California.

L–a Australis—AUSTRALIAN PALMETTO. A Palm tree of eighty feet high. The young leaves can be plaited as palm hats. This will flourish well in California.

Thrinax parviflora. Of West Indies and Central American sandy coasts. The stem of this *Fan-palm* attains to twenty-five feet; fiber for ropes. *T. argentea* is also closely allied.

Copernicia cerifera—CARNAUBA-WAX PALM of Brazil. A magnificent fan-palm: would doubtless prove hardy here in California: the stem furnishes starch: sap, sugar: fiber of leaves, ropes which resist decay in water: can also be used for mats, hats, baskets, brooms, etc.: inner part of leaf stalks for corks. Mainly valued for its carnauba-wax (shed in scales from the leaves), each yielding about four pounds yearly. Millions of pounds are annually imported into this country. Northern Brazil, in south latitude 29°.

Ceroxylon andicola—NEW GRANADA WAX PALM. Ascends the Andes up to eleven thousand feet: one of the most majestic, and at the same time one of the most hardy of all palms; attains to one hundred and eighty feet in height. The trunk exudes a kind of resinous wax, twenty-five pounds to each stem: mixed with tallow, used as candles. The wax in this species exudes from between the insertion of the leaves. Out of a thousand others there must be many worthy of trial on this coast.

C–n australe. Found on high mountains of Juan Fernandez.

Wallichia oblongifolia—Griffith (*Harina*—Hamilt.) Of the Himalaya as far as 29° north. There one of the hardiest of all palms, not tall, but a graceful and useful object of cultural industry. Several species exist.

Wettinia (Angusta?) of Peru. An alpine palm likely to endure our clime: also *W–a maynensis* of Cordilleras of Peru, and like the foregoing, attains to forty feet, altitude of three thousand or four thousand feet.

The most hardy palms of America of the Amazon region *Geonoma*, *Iriartea deltoidea*, and *I–a ventricosa*, which rises to the lofty magnificence of fully one hundred feet. These and *I–a exorrhiza* and several others ascend the Andes as Amazonian palms to five thousand feet—*Oenocarpus multicaulis* to four thousand—so distinctively named as six to ten stems spring from the same root, each fifteen to thirty feet high; of *Euterpe* two species up to six thousand feet; two or three species of superb palms yield the well known *vegetable ivory*, viz.: *Phytelephas microcarpa*, eastern slope of Peruvian Andes to three thousand feet: and *P–s macrocarpa*, up to four thousand: *P–s æquatorialis*, on the western slope up to five thousand. This last named palm is one of the grandest objects in the whole vegetable kingdom—its leaves thirty feet long, stem, or body only rises twenty feet; *palm ivory* is secured largely from these seed also.

Carludorica palmata—R. and P. on the east side of the Andes of Peru and Ecuador, up to four thousand feet. The fan-shaped leaves from cultivated specimens furnish the main material for the best Panama hats. *Jubea spectabilis* of Chili, 40° south latitude: *Trithrinax Brasiliana*, 31° south latitude: *Acrocomia Totai*, 28° south latitude: *Cocos yatai*, 32° south latitude: *C–s Australis*, 34° south latitude; *C–s Romanzoffiana*, 28° south latitude; *Diplothemium littorale*, 32° south latitude. All these last-named palms occur in Brazil; *Acrocomia* and *Trithrinax* extend to Paraguay, and *C. Australis* to Uruguay and La Plata State.

While some palms, as indicated, descend to cooler latitudes, others ascend to temperate and even cold mountain regions. Among American species prominent in this respect are: *Euterpe andicola*, *E. Hænkeana*, *E. longivaginata*, *Diplothemium Porallyi* and *ceroxylon pithyrophillum*—all occurring on the Bolivian Andes at an elevation of about eight thousand feet. *Ceroxylon andicola*, *Kunthia montana*, *Oreodoxa frigida*, and *Geonoma densa* reach also on the Andes of New Grenada an altitude of at least eight thousand feet: *Ceroxylon Klopstockia* to seven thousand five hundred, where Karstan saw stems two hundred feet high, with leaves twenty-four feet long.

There also are found *Syagrus Sancona* and *Platenia chiragua*, at five thousand feet, both very lofty palms. From the temperate mountain

regions of sub-tropical Mexico are known, among others: *Chamædora concolor*, *Copernicia pumos*, and *C–a nana* and *Brahea dulcis*, at elevations from seven thousand to eight thousand feet.

Zalacca secunda—Assam to north 28°. One of the stemless palms with large feathery leaves, exquisitely adapted for decorative purposes. (See Von Martius's great work for full descriptions of this princely order of plants.) Of those suited to our temperate clime those enumerated belonging to boreal extra-tropic Asia, from Silhet, 24° north latitude: *Calamus erectus*, *C–s extensus*, and *C–s quinquenervis*, from Garo at 26° north latitude; *Wallichia caryotoides*, *Ptychosperma gracilis*. *Caryota urens*, *Calamus leptospadix*, from Khrsya, in 26° north latitude; *Calamus acanthospathus*, *C–s macrospathus*, *Plectocomia khasyana*, from Assam, about 27° north latitude; *Areca Nagensi*, *A–a triandra*, *Livistona Jenkinsii*, *Dæmonorps nutantifloras*, *D–s Jenkinsii*, *D–s guruba*, *Plectocomia assamica*, *Calamus tenuis*, *C–s flagellum*, *C–s heliotropium*, *C–s floribundus*, *Phœnix ouseloyana*, from Upper Assam, between 28° and 29° north; *L. Caryota obtusa*, *Talacca secunda*, *Calamus mishmelensis*, from Darjiling, at 27° north latitude; *Wallichia obtusifolia*, *Licuala peltata*, *Plectocomia Himalayana*, *Calamus schizospathus*, from Nepaul, between 28° and 29° north latitude; *Chamœrops Martiana*, from Guhrval, in 30° north latitude; *Calamus Royleanus*, from Saharampoor, in 30° north latitude; *Borassus flabelliformis*, from Duab, in 31° north latitude; *Phœnix sylvestris*, from Kherce, in 30° north latitude; *Phœnix numilis*, from Deccan; *Bentinckia coddapanna*, at four thousand feet altitude.

Encephalartos Denisonii, New South Wales and Queensland Pine–Palm. Very desirable; as also *E. spiralis*, *E. preissii*—great tenacity of life, even of large size; retains vitality for years. Thrives in California.

Aberia Caffra—Kai Apple. Of Natal and Caffraria. A tall shrub for hedges. Rather large edible fruit, and as preserves. There are also allied South African species—*A. zeyheri* and *tristis*.

Acacia Arabica—Gum Arabic Trees. Throughout Africa and Southern Asia. Small trees, to be utilized as thorny hedges; also, *A–a seyal*, and *A–a tortilis*, all furnish the best gum arabic. The lac insect lives on the foliage; thus we find the lac is mainly from this tree.

A–a falcata. Of Eastern Australia. One of the best anti-drift-sand trees; proven at the Cape of Good Hope. Several other species serve the same purpose, quickly restoring woods of sand dunes; *e. g.*, *A. pycnantha*, *A. saligna*, *A. cyanophylla*, and *A. salicina*.

A–a fasiculifera. South Queensland. Desirable for culture on account of the excellence of its easily worked wood.

A–a glaucescens. Queensland and New South Wales to sixty feet; a kind of Myall; hard, dark, pretty-grained, little scented wood.

A–a harpophylla. South Queensland. Yields a large share of "wattle bark" for tanning; wood brown, heavy, hard, and elastic; used by natives for spears.

A–a horrida—Doornboom; Karra Doorn, of South Africa. A formidable hedge bush, with thorns three inches long; exudes a good kind of gum; so, also, *A–a Giraffæ*.

A–a lophantha. Southwest Australia; common in California culture. One of the most rapidly growing trees for copses and first temporary shelter in exposed localities; seldom attains to the size of a real entitled tree; seeds abundantly; germinates most readily; suited to desolate desert tracts; of great importance to create a quick shade, shelter, and copious vegetation; cattle browse on it; bark contains only about eight per cent of mimosa

tannin; the dry root about ten per cent of saponin, valuable in silk and wool factories.

A–a pendula. New South Wales and Queensland. Generally in marshy tracts of the interior; one of the Myall trees.

A–a pycnantha—Of Victoria and South Australia. GOLDEN WATTLE. Deserves extensive cultivation, mainly for bark so rich in tannin. Of rapid growth, succeeds in sandy soil, seeds copiously, and they germinate with the greatest ease; never a large tree. Hon. F. von Mueller has proven the perfectly dry bark to yield twenty-five per cent of mimosa tannin, although in commercial condition contains ten per cent of this in moisture. The aqeous inf. of the bark can be reduced by boiling to a dry extract which in medicine, and other respects, is equal to the best Indian catechu (derived from *A. catechu* and *A. sundra*). This catechu is of great use for preserving from decay articles subject to exposure in water, such as nets, fishing lines, etc. The demand is daily increasing, and has already doubled in the last twenty years. Probably no other tan plants give so quick returns as this, particularly *A. decurrens* or BLACK WATTLE. Any bare, barren, and unutilized place could be sown to profit with a fair warrant of return in a few years. One half pound of wattle gives one pound of leather, whereas it requires five of oak; however, the tannin principle of both is not absolutely identical. With bichromate of potash gives a ruby-red dye; oxides of iron, red-brown; salts of iron, black.

A–a saligna. Of southwest Australia, where it is the principal tree chosen for tanner's bark, containing thirty per cent mimosa-tannin. Small, but widely-spreading tree, fit for avenues. Out of centuries of Acacias many might prove of great use.

Albizzia lebbek.—The SIRIS ACACIA of South Asia. Available in the warmer parts of California as a shade tree; also yields a good deal of gum.

Aloexylon agallochum. Cochin China, on the highest mountains. Would prove hardy here. The precious far-famed aloe wood, renowned for its balsamic fragrance and medicinal properties is derived from this tree.

Backhousia citriodora.—F. von Mueller. South Queensland. Only a small tree, yet worthy of culture for the fragrance of its lemon-scented foliage.

Balsamodendron Ehrenbergi—Deserts of Arabia. This tree yields the resin, myrrh, and a sour native Amyride, the allied *Bursere* indicates would flourish in the more arid parts of California. Prof. Oliver unites this with the following:

B–n opobalsamum—Kunth (*B. Giliadanse*—Kunth). Arabia and Nubia. This species furnishes the Mecca or Balm of Gilead. *B. capense* is closely allied from *S. Africa.* The American Balm of Gilead is from *Icica carana*: Incense wood from *I–a guianensi* American Elemi *I–a icicariba;* Resin of Corenia from *I–a ambrosicaca*; *Icica altissima*, a kind of cedar wood of Guiana (varies white and red). It is light, easily worked, and very aromatic (canoes forty-two feet long by five and a half wide are made from a single tree).

B–n mukul—Of Scinde and Beloochistan. Yields the fragrant Bdellium resin.

Boswellia papyrifera—In Morocco. Nubia and Abyssinia forms forests about Bertat on the atlas. Exudes a kind of olibanum resin, one of the hardiest species. *B–a glabra* yields a coarse resin, boiled in oil for pitching the bottoms of ships.

Berberis siatica—Himalaya. One of the best among numerous species with edible berries: also, *B–s lycium* and *B–s aristata*, which yields, besides a valuable yellow dye wood; the same remarks apply to our native *B–s*

pinnata. *B–s aquifolium* and *B–s fascicularis*, etc. Black or blue bloomed berries; flowers, yellow. Besides other barberries.

B–s Darwinii—Chili and South Chili. Considered one of the most handsome of all evergreen shrubs for garden hedges. Out of fifty species or more, others of great merit could be mentioned.

Butea frondosa—DHAK or PULAS of India. This magnificent leguminous tree extends to the Himalayan Mountains, hence suited to our clime. It is very rich in a peculiar kind of *kino*. The lac-insect is also nourished by this tree.

Buddlea madagascariensis—Madagascar. Of all these the most desirable for shelter copses, on account of its great size, always tidy appearance, and both for vigor and celerity of growth; besides, it is ever-flowering; flowers, as in figworts, like foxgloves.

Buxus sempervirens—Turkey Box Tree. South Europe, North Africa, Southwest Asia. Slow growing tree, and should be timely planted, to provide the indispensable boxwood for the engraver and musical instrument maker, for hitherto no good substitute has been discovered; needs calcareous soil for the best development. There are sixteen to twenty other species of Box, besides several close allies, yet so little is known of them we think it prudent to reserve an opinion. Some are large trees, and may be of more rapid growth.

Cæsalpinia coriaria—DIVIDVI OR LIBIDIBI TREE. Wet seashores of Central America. Could be naturalized in some of our salt marshes. The full grown tree produces annually one hundred pounds of pods, the husk of which is the most astringent of any known substance, and most quick acting tanning material in India. Commercially known as Divi-Divi; price of these pods, forty to sixty-five dollars per ton, or even more.

C–a sappan—Southern Asia. Wood yields a red dye. This shrub could be utilized for hedges; would prove hardy in places free from frosts.

C–a tinctoria—Of Chili. The bark yields a red dye.

Calyptranthes aromatica—BRAZILIAN SPICE–BUSH. Buds a good substitute for cloves and the berries for allspice, and belongs to the same myrtle-bloom family. Another beautiful myrtad, in lat. 50° 30′ S. (Lord Auckland's islands), is the following: *Metrosideros lucida.* These, with their allied genera, *Psidium Cattleyanum* (like our own), bear fruit of excellent quality. The young bark and leaves used in medicated baths. Also, *Eugenia Cauliflora* is one of the most agreeable fruits of Brazil; as well as *E. Nharica*, berries of plum size; *E. pyriformis* and *Super-axillaris*, South Brazil, fruits of pear size; *E. rotundifolia*, Ceylon, to eight thousand feet, so suited to cool or cold climes; also, *E. revoluta*, six thousand feet, like a plum.

Caragana arborescens—PEA TREE, of Siberia. The seeds are of culinary value, but particularly used for feeding fowls. Leaves yield a blue dye.

Cassia fistula. South Asia. The very long pods of this ornamental tree contain an aperient pulp of pleasant taste. Traced by Dr. Hooker to the dry slopes of the central Himalayas.

Casuarina Decaisneana—BEEFWOOD. Of arid Central Australia. The largest and most valuable for our own desert regions; flourishes finely in California. No manifest leaves. Twig resembles scouring-rushes, or, like our Ephedral tea twigs of desert borders. Yields excellent timber, hard, heavy, and resembles the color of raw beef. New Holland war-clubs said to be made of it.

C–a torulosa. New South Wales and Queensland. The wood of this handsome tree is in demand for durable shingles and for furniture work; makes the best of oven fuel.

Catalpa bignonioides—CATALPA TREE, of South United States. Ornamental flowering tree, of ample foliage, and remarkable for rapidity of growth. As durable timber as the best chestnut. Does well here.

Chloroxylon swietenia—the SATIN-WOOD of the mountains of India. A kind of mountain mahogany; like the allied *Flindersia*, have dotted leaves, and so yield an essential aromatic "wood oil" of India; their astringent and fragrant barks cure intermittent and remittent fevers. Also several of these CEDRALADS, *e. g. Cedrela angustifolia*, with a strong odor of garlic; *C. toona*, Eastern Australia, yields a fragrant resin; *C. febrifuga* cures chills and fevers of Java; *Juriballi* bark of Demarara, of this order, a potent bitter and astringent far superior to Peruvian bark in low and malignant fevers, and powerfully diaphoretic taken warm, and is both cordial and cathartic. But *Chickrassia tabularis* bark contains some of these qualities without bitterness. The YELLOW WOOD of New South Wales, and Mahogany, have similar properties, and also belong here. The *Flindersia Bennettiane*, best of the *Yellow-Woods*, for avenue purposes.

Cistus creticus—LADANUM SHRUB, of Mediterranean region, and with *C–s cyprius* furnishes the best Ladanum resin; other species yield a less fragrant product.

Combretum butyraceum—BUTTER-TREE. Of Southeastern Africa; the Caffirs call it, the fatty substance of the fruit, "Chiquito," and is largely used by them as an admixture to their food and for a potation; is one fourth olein and three fourths margarin, aromatic. The *C–m alternifolium* exudes a gum like gum Arabic, soluble in water, but burning away in a candle flame. Many of these myrobalans are like myrtles and laurels; the fruit of the latter, native of California, yields a similar fat.

Terminalia alata. The bark astringent and anti-febrile. The fruit of *T–a chebula*, as also the galls, very much so; highly valued by dyers; with alum a durable yellow; ferruginous mud, an excellent black; some yield excellent timber; kernels of *T–a catappa*, and are eaten as almonds, and are very palatable; those of *T–a citrina* common Hindoo medicinal purge. The milky juice of *T. benzoin*, in dry concretion, the drastic gum is used in Mauritius as incense. These are chiefly adapted to the warmest portion of California.

Fitzroya patagonica—ALERCE. Of the Chilians; grows on swampy, moory places—near kin to the arbor vitæ—to fifteen feet in diameter; wood almost always red, easily split, light, does not warp; stands exposure to the air for half a century; in Valdavia and Chili almost all buildings are roofed with shingles of this tree; ought to be extensively planted in our unutilized swampy moors.

Psidium acidum—AMAZON GREAT GUAVA MYRTLEBLOOM. Mountain regions of the Amazon River; a tree thirty feet high; its guava fruit pale yellow, apple size; makes an excellent cooling conserve.

P–m chrysophyllum. F. v. Mueller. The guabinoba de mato of South Brazil; this tree also about thirty feet, but fruit the size of a cherry: other species of the *Abbevillea* section would be hardy here on the Pacific, and worthy of cultivation; also *P. pyriferum* and *P. pomiferum*, the latter most acid. In the mountains of Brazil *P. lineatifolium* is very promising; berry about an inch in diameter. Another of Uruguay, fruit of similar size, viz.: *P. malifolium.* Surely in the southern regions of this State where the native *psidiums* and *zizyphus* grow and fruit well, some of these would be found to flourish.

Pyrus salicifolia. Greece, Turkey, Persia, and Southwest Russia, fruit so mollifies as to be edible, yet it is mainly utilized as a superior stock for

grafting. So also might the JAPANESE EVERGREEN PEAR of such robust and vigorous growth in Alameda, California.

P–s nivalis or SNOW PEAR. Middle and South Europe. Eminently adapted for orchards of our higher mountain regions; fruit becomes soft and edible through exposure to snow; the wild state of this tree is probably *P. amygdaliformis.*

Rhus caustica—LITRE of Chili. A small sized tree; wood, very hard, superior for cogs, axletrees, and select furniture; neither caustic nor otherwise poisonous.

Royenia pseudo-ebenus—SOUTH AFRICAN EBONY. Only a small tree; wood, jet black, hard, and durable. Together with the following—*R–a pubescens*—suitable for all uses of the wood engraver; suggestive of the adaptability of many other woods in this large order of *Ebenaceæ*, or ebonies; as good substitutes for Turkey Boxwood.

Salix capensis—South African CAPE WILLOW. Close resemblance to the common *Weeping Willow.* The best for binding drifting sand, and for long, flexible twigs for withes, are *S. daphnoides*, of Europe and Asia; *S. petiolaris; S. cordata*, native of Pacific Coast, with *S. triste* and *S. longifolia*, etc.

S–x Humboldtiana—South American. Com'n; pyramidal in habit, to fifty feet or more. The wood is much used for yokes and other implements. A great number of species of willow can be grown for consolidating shifting sand ridges, besides the following beauty, to wit:

Chilopsis saligna. A tree to twenty or thirty feet; often only a bush; seldom over one foot in diameter. This TRUMPET–FLOWERED "*Desert Willow*" on streams and dry creeks of Southern California, through the arid interior, across the continent to Texas.

Santalum album—WHITE SANDAL WOOD. Of India; ascending to the temperate elevations of Mysore. A small or middle-sized tree, famed for its fragrant wood and roots. The greatest fragrance of the wood is generated in the drier and stony parts of mountains and hilly ranges.

S–m Freycenetianum produces sandal wood on the mountains of the Sandwich Islands up to three thousand feet. Several other species occur in Polynesia. The precious sandal oil is obtained by slow distillation from the heart wood and root, the yield being about two and one half per cent. In California, free from frosts, there can be no doubt of its feasible culture.

Saxe-Gothea—the MAHIN of Southern Chili. A middle-sized coniferous tree, already flourishing and seeding on this coast; has fine grained, yellowish wood.

Santolina Chamæcyparissus. Mediterranean region. A very aromatic and handsome bush, of medicinal repute; several allied species.

Sophora tetraptara—PELU of Chili and Patagonia. A small tree, with exceedingly hard and durable wood; much used for cogs, wheels, journals, and like mechanical structures.

S–a speciosa, or *Arizonica*, are large evergreen tree shrubs, very ornamental, especially those on the uplands of Texas. The terminal racemes of violet, lupin-like blooms, are very beautiful, and the wood may prove equally good.

Spondias (cytherea) dulcis—REWA. Fiji, Tongan, and Society Islands. A noble tree, to sixty feet high, laden with golden fruit of agreeable apple flavor (some compare both fragrance and flavor to the pineapple), and of "over eleven pounds weight." (?) These should be tested, as some species grow in Eastern Australia.

Swietenia Mahogani—The MAHOGANY tree. West India. The tolerance of this famous tree is not sufficiently known. In its native mountains it

ascends to three thousand feet, and if well sheltered this valuable timber probably could be grown on this coast.

Synoum glandulosum—Of New South Wales and south Queensland. This evergreen tree deserves cultivation in sheltered, warm, forest valleys, on account of its rose-scented wood. Some species of allied Dysoxylon have the odor of garlic—are even used in its stead.

Tamarix Gallica—French Tamarisk. Southern Europe, southern Asia, northern and tropical Africa. This shrub adapts itself in the most extraordinary manner to all sorts of localities—will grow alike in water and on the driest soils—and is one of the most grateful and tractable plants under culture; readily multiplied from cuttings which strike as easily as a willow, and push forth stems of unusual vigor; thrives well in California contiguous to the deserts of Mono Valley and elsewhere; hence one of the most eligible bushes, apart from its beauty, for planting on coast or interior to stay moving sands, or binding embankments. Our railroad interests can urge no objection whatever to its use.

T–x articulata—Jointed Tamarisk. Northern and middle Africa and southern Asia. Of similar utility as *T. Gallica*. Also the same, or an allied species, extends to Japan.

T–x Germanica—German Tamarisk. Europe and western Asia. Likewise available for arresting the ingress of shifting sand, particularly in moist places; also for solidifying precipitous gulch and river banks, or to preserve wet weather runways and dry creeks from fearful gullying and loss of valuable lands. Its modest and relatively leafless mien are like a gauzy veil o'er the face of beauty—never aggressive nor overshadowing.

Tarchonanthus camphoratus. South Africa. This bush deserves attention medically. As an odorous rural plant is most acceptable.

Tectona grandis—Teak. Of South Asia. This superb timber-tree has its northern limit in Bandalkland, at elevations of two thousand feet, which ought to encourage test-culture here.

Terminalia catappa—Beleric Myrobalan. India; ascending mountain regions. Few trees, as stated by Roxburg, surpass this in elegance and beauty. The seeds, kernels, or nuts, are eaten as almonds; palatable, of flavor of the filbert, and very wholesome. Its naturalization is especially desirable on account of the nuts. *T–a parviflora*, of Ceylon, forms a large tree, up to four thousand feet; the astringent fruits of several species form articles of trade, and much sought after for a lasting black dye.

Tristania conferta. New South Wales and Queensland. A noble, shady tree, of one hundred and fifty feet. Fine for extended avenues, etc., besides producing select and lasting timber; ribs of vessels from it have lasted unimpaired thirty years or more.

Triphasia aurantiola. Southeast Asia. A shrub worth cultivation for the exquisite fragrance of its flowers. The fruits, though small, are of pleasant sweetness. Might also be used for hedges.

Villebrunia integrifolia. India; Himalayan Mountains, to five thousand feet. A small tree, allied to the Ramie plant (*Bœhmeria nivea*). The fiber regarded as one of the strongest in India, being used for bow-strings. Other species, *e. g.*, *V. frutescens* also. Some *Debregeasia*—particularly *D. velutina*—deserve regular culture for the sake of their fiber. Particularly adapted, like the following section, to very moist ranges, of one hundred to two hundred inches.

To dwell on details of situation, soil, or clime, with reference to each particular tree, or a thousand and one other conditions, known or presump-

tive, would extend this catalogue to a very large volume, indeed; hence, to note at all must imply this feasibility for the few named. Suffice to say, in general terms, that the following New Zealand list of the Hon. James Hector's Hand Book* are better suited to Northern California, alpine or coast, and to Oregon, northward, where the Pacific climate is similar to that of New Zealand or Old and New England, *i. e.*, differing essentially from the general arid clime of Australia, and of Middle and Southern California, or approximate Arizona and Mexico.

ORDER CONIFIRÆ.

Dammara australis—Kauri Pine. The finest forest tree of New Zealand; one hundred and twenty to one hundred and sixty feet; eighty to one hundred feet of free shaft; ten to twenty in diameter. In high repute for masts and spars; durable for half a century, and even excavated after indefinite ages. The mottled kauri richly shaded, and diagonally cut to markings for furniture, etc. Occurs now only in North Island, and north of Mercury Bay, near the sea, on wet clay soils, mixed with other trees. The turpentine forms the celebrated "kauri gum," extensively exhumed from the sites of old extinct forests. (Of five thousand tons annually exported, the commercial value is about $3,000,000.)

Libocedrus doniana—Kawaka, or as Mock Cypress and Cedar. A handsome tree of sixty to one hundred feet, by three to five; wood reddish, fine-grained, and heavy; used by the Maories for carvings; makes excellent planks and spars. Abounds in the forests of North Island and the Bay of Islands, to north of Auckland.

L–s Bidwellii—Phantea, Cedar. A handsome conical tree, of sixty to eighty feet high. In Otago it produces a dark-red, free-working but rather brittle timber, mostly for inside work. On central ranges of North Island and common throughout the forests of South Island, at altitudes of five hundred to four thousand feet. For railroad sleepers and for fencing; formerly deemed only fit for inside work.

Podocarpus ferruginea—Miro, Bastard. Black–Pine, of Otago. A large ornamental and useful timber tree, of forty to sixty feet by two to three. Not so useful as the true Black Pine, or "Matai." Reddish wood, close grained, and brittle; durable when only partially exposed to sea water. In north and south islands, below one thousand feet.

P–s spicata—Matai, Mai. Black–Pine, of Otago. A large tree, of eighty feet by two to four. Wood yellowish, close grained, and durable. Of various uses, as piles for bridges, wharves, and jetties, bed-plates of machinery, millwright-work, flooring, house blocks, railway sleepers, fencing, etc. Logs exposed for at least two or three hundred years in overgrown dense damp wilds of North and South Islands. At altitudes under fifteen hundred feet.

P–s totara—Totara. A lofty spreading tree, sixty to one hundred feet by four to ten feet diameter. Wood very durable, and clean grained, in appearance like cedar, and works with equal freedom. Adapted to all kinds of carpenter's work; largely used in Wellington for house building, piles of bridges, and for wharves, and for railroad sleepers. One of the most valuable timbers known. The wood, if felled during the growing season, *resists the teredo* for a long time; splits freely, making durable fences and shingles, and as post-and-rail fences expected to last forty to fifty

*New Zealand Hand Book, by Hon. James Hector, M.D., C.M.G., F.R.S., Director of Geological Survey.

years. The Maories make their largest canoes of this tree, also palisades. Throughout North and South Islands, on both flat and hilly ground, the latter most durable.

P–s dacrydioides.—"KAHIKATEA." *New Zealand* WHITE PINE. A fine tree, one hundred to one hundred and fifty feet by four. Timber white, tough, and soft; for indoor work only, unless grown in dry soils; abounds in North and South Islands.

Dacrydium cupressinum.—"RIMU." New Zealand RED PINE. Pyramidal, with weeping branches when young; eighty to one hundred and thirty feet by two to six feet; both ornamental and useful timber; red, clear-grained, solid and heavy; much used for joists, planks, and for general building, and some furniture. Wellington southward. Handsomely marked, like rosewood, but lighter brown hue: decays by wet: juice like spruce for making beer. North and South Islands, but best inland.

D–m colensoi.—"MANOAS." *New Zealand* YELLOW PINE. A very ornamental tree, twenty to eighty feet: wood light yellow, the most durable and strongest timber of New Zealand. Posts of this wood have been in use among the Maories several hundred years. North and South Islands; up to four thousand feet altitude. A curious tree from having two kinds of leaves on the same branches; greatly valued for furniture.

Phyllocladus trichomanoides—"*Tanekaha*," CELERY-LEAVED PINE. A slender, handsome tree sixty feet high, rarely exceeds three in diameter: wood pale, close grained, excellent as planks and spars, remarkable for resisting decay under moisture; grows in the hilly districts of North Island.

P–s alpinus—"TOATOA." A small ornamental and densely branched tree of two feet diameter; bark for dyeing, and making tar; North and South Islands.

ORDER CUPULIFERÆ.

(Of the BEECH, or *Fagus.*)

Fagus menziesii—MENZIE'S NEW ZEALAND BEECH, or RED BIRCH. (From the color of the bark); native "TAWHAI." A handsome tree, eighty to one hundred feet by two to three; timber durable; adapted to masts and oars, cabinet and cooper's work. Lake district of South Island at all altitudes up to three thousand feet, and in North Island on mountain tops.

F–s fusca—"TAWHAI," "TAWHAIRANUI"—"BLACK BIRCH" of Auckland and Otago (from color of the bark). A noble tree, sixty to ninety feet by five to eight; timber excessively tough and hard, both strong and durable for all uses. Found from Kaitaia, in North Island, to Otago, in South Island, up to three thousand feet altitude.

F–s solandri—WHITE BIRCH (from color of the bark) of Nelson and Otago. A lofty and beautiful evergreen one hundred feet high by four to five; heart black and very durable; for bridge piles, fencing, and bark for tanning. Occurs in southern part of North Island, and abounds in South Island at three to five thousand feet altitude.

ORDER—MYRTACEÆ. MYRTLEWORTS.

Leptospermum ericoides—MANUKA. A slender tree ten to eighty feet: highly ornamental, especially young; furnishes timber twenty-eight to thirty feet by fourteen inches at the butt, thence tapering to ten inches; wood dark and hard; largely used for fuel, fencing, ax, and tool handles, sheaves

of blocks, and by natives for spears and paddles—old timber of darker markings for cabinet work, and its great durability commends it for many other purposes. Highly valued in Otago for jetty and wharf piles, as it resists marine worms better than any other timber of the district; also much used for house piles, etc; the lightest colored woods deemed best and toughest, designated "WHITE MANAKA;" good substitute for "hornbeam" in cogs of large spur wheels. Found on the poorest soils.

Metrosideros lucida—RATA, IRONWOOD. A very ornamental tree; attains to thirty and sixty feet, by two to ten feet in diameter; valuable cabinet-wood; dark-red, splits freely, is used as knees and other ship timbers, would form cogs, etc. Rare in North Island, abundant in South Island, especially mountain coast.

M–s robusta—RATA. A tall erect tree of fifty to sixty feet by four; descending roots apt to form a hollow base twelve feet in diameter; timber like the last, *M. lucida*; equally dense and durable, but of larger dimensions. Grows on hilly situations of North Island from Cape Colville southward.

M–s tomentosa—POHTUKAWA. A tree of numerous massive arms, thirty to sixty feet, two to four in diameter; timber specially adapted to ship-building, and of quality superior to preceding (*M. robusta*). Grows on rocky coasts of the provincial district of Auckland.

ORDER—MELIACEÆ. MELIADS.

Melia azederach—PRIDE OF ASIA. Persia. The umbrella variety, preferable for rural shades; twenty to forty feet high by two to three through. Wood, durable; summer-green foliage large, clean, compounded; lilac flowers fragrant in open panicles; drupe-fruited or berry-like, sweetish and oily; eaten by domestic animals. Thriving in all, even sandy soils, and best if humid; growth luxuriant and rapid; the best of shades; suited to the interior of California, but does not do well on the coast.

Dysoxylon spectabile—"KOHE KOHE." A large forest tree, forty to fifty feet high; the bitter leaves used as a stomachic infusion; wood tough, but splits freely; durable as piles under sea water. North Island.

Eugenia maire—"MAIRETAWHAKE." A small tree of forty feet by one to two feet; timber compact, heavy, and durable; used for mooring posts, jetty piles, and also valuable as fencing. Swampy land of North Island.

ORDER—ONAGRACEÆ. ONAGRADS.

Fuchsia excorticata—KOTU KUTU. The fruit is called *Konini*. A small and ornamental tree, ten to thirty feet; sometimes three feet in diameter; timber durable; house-blocks of this wood are still sound after twenty years; could be used as a dye stuff, rasped and bled in the usual way, and by mixing iron as a mordant; shades of purple to black as a writing ink; juice astringent and agreeable; yields a medical extract; fruit pleasant, and is the principal food of the wood-pigeon. Throughout the islands.

ORDER—ARALIACEÆ. IVYWORTS.

PANAX *crassifolium*—"HOROEKA." IVY TREE. Ornamental, slender, and sparingly branched tree, singularly graceful in the young state, with long reflexed leaves; wood close-grained and tough; common throughout the islands.

Fatsia (Panax) *horrida*. A prickly shrub of six to eight feet, in Califor-

nia cañons as far south as Tamalpais Mountain, and northwardly to the Arctic: foliage one to two feet across. The following allied plant also should be tested.

Gunnera scabra—PANKE. Sandstone cliffs of Chiloe. Leaves eight feet across, and four or five of these Darwin found on a single specimen, like rhuebarb on a gigantic scale; these enormous leaves "presenting together a noble appearance!" Astringent; roots used by tanners, and fleshy leaf stalks eaten.

ORDER—ERICACEÆ. HEATHS, OR HEATHWORTS.

Dracophyllum longifolium—NEINEI. An ornamental shrub tree, with long grassy leaves: wood white, marked with satin-like specks: fine for cabinet work; in Sandwich Islands, and in Lord Auckland's group: Campbell Island; in the vicinity of Dunedin to ten to twelve inches in diameter.

ORDER—VERBENACEÆ. VERBENAS.

Vitex littoralis—PURIRI. A large tree, fifty to sixty feet: trunk six to seven feet diameter: wood hard, dark olive brown; much used: reputed indestructible under all conditions: northern parts of North Island only: supremely valuable for railroad sleepers; perhaps only equaled by its kin TEAK, *Tectona grandis*; of the forest mountains of Malabar, Pegu, and other East Indian districts: an enormous deciduous tree: timber abounds in particles of silex, and has no rival in Asia for durability; the wood has much the appearance of coarse mahogany, and though lighter, is very strong, and for ship building perhaps the best in the world: flowers diuretic, and foliage yields a red dye.

ORDER—LAURINEÆ. LAURELS.

Nesodaphne tarairi—"TARAIRI." Forest tree, sixty to eighty feet, with stout branches: wood white: splits freely, but little used. Northern parts of North Island.

N–e tawa—"TAWA." A forest tree, sixty to seventy feet, with slender branches; wood light and soft; much used for butter-kegs. Northern parts of South Island and in North Island, in large forests of river flats.

ORDER—CORNEÆ. CORNELS.

Griselinia littoralis—PUKATEA, BROAD–LEAF. An erect, thickly-branched bush-tree, fifty to sixty feet high, three to ten feet in diameter; wood splits freely; valuable for ship-building and for fencing; and portions of it make fine veneers. Found chiefly in the South Island, near the coasts.

ORDER—COMPOSITEÆ. COMPOSITES.

Olearia avicenniæfolia. MINGIMINGÉ. YELLOW–WOOD. An ornamental shrub-tree: flowers numerous: trunk two feet in diameter; wood close-grained, with yellow markings, which renders it desirable for cabinet-work. Mountains of North Island and throughout South Island.

O–a cunninghamii. Ornamental shrub tree of twelve to twenty feet high: flowers very showy; abundant on the west coast of South Island, and in North Island.

ORDER—MONIMIACEÆ. MONIMIADS.

Atherosperma novæ-zealandica—"PUKATEA." Tree one hundred and fifty feet, buttressed fifteen feet of the base; trunk three to seven diameter; wood soft and yellowish; fine for small boat planks. A variety has dark wood that is very lasting in water; prized by Maories for canoes. North Island and the northern parts of South Island.

Hedycarya dentata—"KAIWHIRIA." A small evergreen tree, twenty to thirty feet high; wood finely marked, and suitable for veneering. North Island, and so far south as Akaroa, in South Island.

ORDER—PROTEACEÆ. PROTEADS.

Knightia excelsa—"REWAREWA." A lofty, slender tree, one hundred feet high; wood handsome, of mottled red and brown; most valuable for veneering, and for shingles and fencing, as it splits easily. In the forests of North Island, upon hills of both rich and poor soils.

ORDER—MAGNOLIACEÆ. MAGNOLIAS.

Drimys axillaris—"HOROPITO," PEPPER TREE. *Winter's Bark*. A small, slender evergreen; very handsome; whole plant aromatic and stimulant; much used by the Maories for various diseases; wood very ornamental in cabinet work; makes beautiful veneers; grows abundantly in forests throughout the islands, at altitudes of one thousand feet; foliage becomes dense and reddish.

D–s colorata. Very distinct species; quite common near Dunedin. A very ornamental shrub tree; leaves blotched with red.

.ORDER—VIOLARIEÆ. VIOLETWORTS.

Melicytus ramiflorus—"MAHOE." "HINAHINA." A small tree, twenty to thirty feet high by two feet or so diameter; wood soft; not in use. Abundant throughout the islands so far as Otago. Leaves greedily eaten by cattle.

ORDER—MALVACEÆ. MALLOWWORTS.

Moheria populnea—"HOUHERE." RIBBONWOOD, of Dunedin. An ornamental shrub-tree, ten to thirty feet high; bark fibrous, and used for cordage and cloth of Maories. Affords a demulcent drink. The wood splits freely for shingles, etc., but is not durable. Abundant throughout the islands.

ORDER—ANACARDIACEÆ. ANACARDS, OR TEREBINTHS.

Pennantia corymbosa—"KAIKOMAKO." A small but very graceful tree, with white sweet-scented flowers; twenty to thirty feet high; wood used by the Maories for kindling fires by friction. On the mountains of North Island, and abounds on the South Island.

ORDER—RHAMNEÆ. RHAMNADS.

Discaria toumatou—"TUMATAKURUS." WILD IRISHMAN. Bush or small tree of spreading branches; properly trained would form a handsome hedge stronger than the white thorn; spines used by natives for tattooing.

ORDER—SAPINDACEÆ. SOAPWORTS.

Dodonæa viscosa—"AKE." Wood very hard, variegated black and white; used for Maori-clubs; abundant in dry woods and forests.

Alectryon excelsum—"TITOKI." A beautiful tree, with large panicles of reddish flowers; trunk fifteen to twenty feet high, foot or more in diameter; wood like ash, and used for similar purposes; its toughness renders it valuable for wheels and for coach building generally; the oil used for anointing. In North and South Islands, abounds in forests.

ORDER—LAGUMINOSEÆ. LEGUMINOUS PLANTS.

Sophora tetraptera—"KOWHAI." A small or middle sized tree of splendid appearance, with large pendulous yellow flowers; wood red, highly durable, and valuable for fencing and cabinet work, for bridges, piles, and wharves, etc. Abounds throughout the islands.

ORDER—SAXIFRAGEÆ. SAXIFRAGES.

Carpodetus serratus—"WHITE MAPAU." WHITE BIRCH. (Of Auckland.) A small tree of ten to thirty feet; slender branches, spreading, fan-form, very ornamental, with a profusion of white flowers; wood soft and tough, good for ax and other handles. North and South Islands, by river banks.

Weinmannia racemosa—"TOWHAÏ." KAMAKI. A large tree, fifty feet high, two to four feet in diameter. Wood close-grained and heavy but rather brittle; good for joiner's tools and carving blocks, for paper and calico-printing, turnery and wood-engraving, etc. Bark largely used for tanning. Yields an extract like gum Kino. Middle and southern part of North Island and throughout South Island.

ORDER—RUBIACEÆ. STELLATES OR MADDERWORTS.

Coprosma Clinearifolia—KARAMU. An ornamental shrub-tree; wood close-grained and yellow; might be used in turnery; grows in the mountains of North and South Islands. Other species grow to considerable size, and have highly ornamental timber. *C–a baueriana* commended as a substitute for coffee.

ORDER—JASMINEÆ. JASMINWORTS.

Olea Cunninghamii—BLACK MAIRE. Tree forty to fifty feet high, three to four feet diameter. Timber close-grained, heavy, and very durable—abounds.

ORDER—SANTALACEÆ. SANDALWORTS.

Santalum Cunninghamii—"MAIRE." A small tree ten to fifteen feet high, six to eight inches diameter; wood hard, close-grained, and heavy. Used for war implements of Maoris; substitute for box by wood-engravers.

Erythroxylon coca—COCA, SPADLE. A highland Peruvian shrub, famed for the marvelous energizing properties of the leaves; their almost fabulous power over privation and fatigue, which enables the coca chewer to endure unwonted and persistent labor, greatly commend it to trial culture. They contain two alkaloids, cocain and hygrin, also a peculiar tannic acid.

Phœnix dactylifera—DATE PALM. North Africa and inland Arabia and

Persia. This noble palm attains to eighty feet; is unsexual; of great longevity. The sap yields sugar or palm wine, the leaves for hats, mats, etc.; a fine scenic landscape ornament; famous food, fruits in succession throughout the season in bunches of two hundred or so; a great boon of the oasis of desert tracts, mountain valleys, and even-tempered lowlands; the unexpanded flower-bunches can be used as palm-cabbage, and the fiber of the leaf stalk for cordage. In the south of Europe date forests prove of immense value, and the ease with which this palm grows from seed affords great facility of culture in southern and southeastern climes of California. The varieties of Gomera are large, and contain no seed; varieties vary in shape, size, and color of fruit.

Plectocomia Himalayana—Rattan Palm. Sikkim, up to seven thousand feet. Requires moist forest land. Of such diverse utility is worthy of culture, but the canes are not durable; hardiest among its congeners.

Calamus montamus—The Climbing Cane Palm. *Himalaya* up to six thousand feet; hardy climbing palm. Aged canes naked. Of these the light, strong suspension bridges over the large rivers of Sikkim are made; supplies the strongest ropes for hauling logs from the forests. The most durable baskets and cane-work of chairs are made from the slits; also, walking-sticks, riding-canes, etc., are cut from this and other species of calami, but few, if any, are equally hardy.

Bactris gisipæs—H. (guilielma speciosa, Mort.)—Peach Palm. Of the Amazon River; stems clustered to ninety feet; mealy pericarp cooked; superior to chestnut; an object of great grandeur.

Raphis flabelliformis. China and Japan; very slender palm, only a few feet high, for table decoration.

Bambusa arundinacea—Thorny Bamboo. India; requires rich moist soil, and delights on river banks; not so high as *B. vulgaris*; sends up numerous stems from the root; the branches bending, thorny at the joints; seeds useful food for fowls.

B–a attenuata—Hardy Bamboo of Ceylon. On mountains four thousand to six thousand feet; to a height of twenty-five feet.

B–a elegantissima. Mountains of Java; four thousand feet; very tall, and exceedingly slender; upper branches pendulous; a hardy species.

B–a monadelpha. Ceylon; on mountains four thousand to six thousand feet high; a dwarf but handsome bamboo of only twelve feet.

B–a spinosa. Bengal tall species; cavity small and hence strong.

B–a stricta. India, particularly Bengal; on drier ground than *B. arundinacea;* smaller, and quite straight, more strong and solid.

B–a vulgaris—Common Bengal Bamboo. Large and unarmed; attains to seventy feet; may even reach forty feet in a single season; resists occasional frosts; best for building houses; in water for some time renders the cane still firmer. To the large and thornless bamboos belong *B. tulda*, *B. balcooa*, of India.

B–a Thouarsii. From Madagascar and Bourbon. These and many others much used for various furniture, mats, implements, etc.

Guadua augustifolia. New Granada, Ecuador, and other Central American states. Forty feet. May prove hardy in sheltered places of some lowlands.

G–a latifolia. One of the tall bamboos of Central America. This guadua is stouter than any Indian bamboo. In tropical America native bamboos are planted for hedges.

Psidium Araca—Greenish-Yellow Guava. West India and Guiana to Peru and Brazil, where it is in dry high-lying places. Greenish yellow berry of exquisite taste.

P–m arboreum—THE GUAVA. Brazil; Province of Rio Janeiro. Fruit about one inch, and excellent flavor.

P–m Cattleyanum—PURPLE GUAVA. Brazil and Uraguay. One of the hardiest of guava bushes; attains to twenty feet. Purple berries, seldom over one inch long, but delicious flavor; taste like strawberries. *P. buxifolium*, of Florida, seems nearly related to this species. *P. cinereum*, Brazilian Province of Minas Geraes, yields an edible fruit. *P. cuneatum*, also; greenish; size of plum.

P–m cordatum—SPICE GUAVA. West India. A tree; fruit edible.

P–m grandifolum. Brazil. Rather dwarf shrub. Berries size of a walnut; edible.

P–m Guayava.—The LARGE YELLOW GUAVA. Of India, Mexico, to South Brazil. This handsome and very useful evergreen bush should become a universal favorite in all our warm low lands for the sake of its aromatic, wholesome berries—the size of a hen's egg—which can be converted into a delicious jelly. The pulp, generally cream-colored or reddish, varies with varieties under culture, and some bearing all the year round. Propagation is easy from suckers, cuttings, or seeds.

P–m polycarpon. From Guiana to Brazil; also in Trinidad. A comparatively small shrub, bearing prolifically and almost continuously its yellow berries, size of a large cherry, and of exquisite taste.

P–m rofum. Brazil, in province of Minas Geraes, on subalpine heights; to ten feet, and is likely the hardiest of all the species producing palatable fruit.

Adenostemum nitidum.—South Chili. QUEALE, NABLE, and ARACOCO. A stately tree; wood durable and beautifully veined; fruit edible.

Juglans Sieboldiana. Throughout Japan, where it forms a large tree; *J. cordiformis* closely approximates it. The *J. Mandschurica* of that place and Corea is a walnut allied to our *J. cinerea* or butternut. None of these trees, however, will attain proper size or prosperous growth if the tap-root is cut off or leadertop.

SWEET-FERN TREE. (New.)—*Lyonsthamnus, asplenifolius.* Greene, California.

Lycium Afrum.—Africa and southwest Asia. Our native *L. Andersonii*, and several others, also bear beautiful amber edible berries, and might be utilized as hedge bushes, and as stocks for choicer sorts.

The bamboos already introduced flourish so well in California more should be tested. Being of such manifold use, grandest among grasses, elegant and graceful, and as many of them delight in the cooler mountain air, of the easiest possible culture, and the most rapid growth, out of about two hundred, or say possibly three hundred sorts, we quote a few following furthermore from Baron F. von Mueller's list, to wit:

Arundinaria Japonica. To twelve feet.

A–a macrosperma. North America, thirty-five feet.

A–a verticillata. Brazil, to fifteen feet.

A–a debilis. Ceylon, up to eight thousand feet; a tall species.

A–a acuminata. Mexico, twenty feet high.

A–a falcata. Himalaya; ascends to ten thousand feet; twenty feet high.

A–a tesselata. South Africa; ascends to six thousand five hundred feet; twenty feet high.

A–a callosa. Himalaya, to six thousand feet; twelve feet high.

A–a Khosiana. Himalaya, also six thousand feet; twelve feet high.

A–a Hookeriana. Sikkim, up to seven thousand; fifteen feet high.

A–a suberecta. Himalaya, four thousand five hundred; fifteen feet high.

Thamnocalamus Falconeri. Himalaya, to eight thousand feet; tall.

T–s spathiflorus. Himalaya, to ten thousand feet; tall.
Phyllostachys bambusoides. Himalaya, China, and Japan; twelve feet.
P–s nigra. China and Japan, twenty-five feet.
Arthrostylidium longiflorum. Venezuela, to six thousand feet.
A–m excelsum. West Indies, eighty feet high by one foot diameter.
A–m racemiflorum. Mexico, to seven thousand five hundred; thirty feet high.
Aulonema Quixo. New Grenada and Venezuela; cool regions; tall and climbing.
Macrostachys ternata. Southern Brazil; height twenty feet.
Also, *M–s Clausseni*, of Southern Brazil, eighty feet, and *M–s Kunthii*, of Southern Brazil, thirty feet.
Chusquea simpliciflora. Panama, eighty feet; scandent.
C–a abietifolia. West Indies; tall scandent.
C–a culcou—Chile, twenty feet; straight.
C–a uniflora. Central America, twenty feet.
Chusqua Galleottiana. Mexico; to eight thousand feet.
C–a montana. Chile Andes, ten feet.
C–a Dombeyana. Peru, to six thousand feet; ten feet.
C–a Fendleri. Central America, to twelve thousand feet.
C–a Scandens. Colder Central America; climbing; tall.
C–a Quila. Chile; tall; also, *C–a tenuiflora*; twelve feet high.
C–a Guadichaudiana and *C–a capituliflora.* Both very tall. South Brazil.
Platonia nobilis. New Granada, colder region.
Nastus Borbonicus. Bourbon, Sumatra; to four thousand feet; fifty feet high.
Guadua Tagoara. South Brazil; to two thousand feet; thirty feet high.
G–a macrostachya. Guiana to Brazil; thirty feet high.
G–a capitata. South Brazil; twenty feet; and *G–a virgata*, twenty feet.
G–a refracta. Brazil; thirty feet; and *G–a paniculata*, thirty feet.
Bambusa nutans. Ascends Himalaya to seven thousand feet.
B–a tuldoides. China, Hong Kong, Formosa.
B–a pallida. Bengal to Khasia; to three thousand five hundred feet; fifty feet high.
B–a polymorpha. Burmah, in the Teak region; eighty feet high.
B–a Balcooa. Bengal to Assam; seventy feet high.
B–a flexuosa. China; to twelve feet.
B–a Blumeana. Java; tall.
B–a arundinacea. South India; fifty feet.
B–a Spinosa. Bengal to Burmah; one hundred feet high.
B–a vulgaris. Ceylon and elsewhere in India; to fifty feet high.
B–a Beecheyana. China; twenty feet high.
B–a marginata. Tenasserim; ascends to five thousand; tall; scandent.
B–a regia. Tenasserim; forty feet high.
B–a Brandisii. Tenasserim; up to four thousand; one hundred and twenty feet high by two feet girth.
Gigantochloa maxima, Kurz; (*Bambusa verticillata*, Wild). Java; grows to one hundred feet.
G–a attar. Java; to forty feet.
G–a heterostachya. Malacca; to thirty feet.
Oxytenanthera Abyssinica. Abyssinia to Angola; to four thousand feet; height fifty feet.
Oxytenanthera nigro-ciliata. Continental and Insular India; to forty feet.
O–a albo-ciliata. Pegu, Moulmein; tall; scandent.

O–a Thwaitesii. Ceylon; to five thousand; height, twelve feet.

Melocanna bambusoides. Chittagong, Sylhet; to seventy feet.

Schizostachyum Blumei. Java; very tall.

Cephalostachyum capitatum. Himalaya; to six thousand; thirty feet high.

C–m pallidum. Himalaya; up to five thousand; tall.

C–m pergracile. Burmah; to forty feet.

Pseudostachyum polymorphum Himalaya; to six thousand feet; very tall.

Teinostachyum attenuatum, Munro; *(Bambusa attenuata,* Thw.) Ceylon; ascends to six thousand feet; twenty-five feet high.

T–m Griffithi. Burmah; tall; slender.

Beesha Travancoria. Madras; tall.

B–a Rheedei. South India; Cochin-China; twenty feet high.

B–a stridula. Ceylon.

Beesha capitata. Madagascar; fifty feet.

Dendrocalamus strictus. India to Japan; to one hundred feet.

D–s sericeus. Behar; to four thousand feet; tall.

D–s flagellifer. Malacca; very tall.

D–s giganteus. Burmah; Penang; exceedingly tall, by two feet.

D–s Hookeri. Himalaya; ascends to six thousand; fifty feet high.

D–s Hamiltoni. Himalaya; also six thousand feet; sixty feet high.

Dinochloa Tjankorreh. Java; Phillippine; ascends to four thousand feet; climbing.

Ægiceras majus. South Asia, Polynesia, North and East Australia, South to New South Wales, the *Mock–Mangrove.* For staying the off-flow of tide mud, and thus consolidating shores subject to sea floods.

Ailanthus glandulosa. Valuable for reclaiming coast lands. Wood extremely durable.

Avicennia officinalis. Dr. Behr's suggested tree for consolidating muddy tidal shores. South Asia and South Africa, Australia, and New Zealand.

Berberis buxifolia—Boxleaf Barberry. Chile, Straits of Magellan. Bush the best for berries of South American species, relatively large, black, but hardly acid; slightly astringent; edible.

Cajanus Indicus—Tree Pea. India and Africa. Attains to fifteen feet; yields four thousands pounds of peas to the acre; can be used as peas in the green or mature state; requires the richest soils of Egypt. Yields a fair crop the first year.

Zizyphus lotus—Lote–Bush. The tree bush which gave name to the ancient *Lotophagi*; the fruit is to this day collected as food by the Arabs of Barbary. As we have a native species, *Z. Parryi*, fruit of the size of a cherry or small plum for preserves, the foreign will no doubt flourish well.

Z–s jujuba. East Australia; subtropic latitudes, and likewise Africa. Attains height of forty feet.

Melicocca bijuga. Mountains of Central America, West Indies. Cultivated in Brazil for its agreeable sub-acid vinous berries, having the pulp of grapes and similar taste, and the seeds can be used as sweet chestnuts. A tree of sapindaceous or horse-chestnut alliance.

Moringa pterygosperma—Horse–Radish Tree. India; middle mountain region. The long pods edible. Seeds somewhat almond-like, rich in oil. *M. aptera* is in Abyssinia. Egypt, Arabia, and Syria.

Morus celtidifolia—Nettle–Leaf Mulberry. Peru to Mexico; up to seven thousand feet. Fruit edible. *M. insignis*, from New Granada, is a similar species.

Myoporum lætum—New Zealand. "Nagio." As a shelter tree, equal to *M. insulare* for the most exposed parts of the coast. Excellent for shade,

and wood takes a fine polish. Can be raised on the beach, from cuttings. Sheep and horses browse on the foliage.

Myrica cerifera—The Wax Myrtle, of United States. *M. Cordifolia*, South Africa, and *M. quercifolia* and *M. serrata* are wax bushes suited to fixing the rolling sands of seacoasts. Myrica-wax is heavier than beeswax, harder, more brittle, and takes a smoother surface, but melts easier. Is obtained from the surface of the fruit, by boiling during the cool season. Sowing the seed after the first rains of the cool months has steadied the sand, or plants can be multiplied by cuttings. It also spreads by subterranean creeping stems, with age.

Myrtus edulis, Benth. (*Myrcianthes edulis*, Berg). Uruguay. Tree attaining the height of about twenty-five feet. Berries one and one half inches diameter, of pleasant taste.

Dendromecon flexilis. Greene (New).

REPORT OF THE ENGINEER

OF THE

STATE BOARD OF FORESTRY.

LETTER OF SUBMITTAL.

To the State Board of Forestry: the Hon. Abbot Kinney, *the Hon.* Jas. V. Coleman, A. Kellogg, M.D.:

Gentlemen: During the month of May last, I was commissioned to visit such portions of the timbered districts of the State as the time remaining to the Board to prepare its first annual report would admit of. I was directed to prepare a forestry map of the districts visited, and to collect all obtainable information bearing upon the subject of forestry; not merely considering the same as the art of fostering and maintaining the growth of trees, but with reference more particularly to the influence which forests have upon climatic conditions, and the amount of water carried by streams. I was instructed to determine the extent and character of the wooded districts visited, to estimate their capacity for furnishing useful woods, to note the rate of decrease under present market demands and from other causes, as also to examine their reproductive capacity and the extent and rapidity of new growths; in short, to collect all data which might assist the Board in determining the probable conditions which the changes in course of progress are liable to produce.

The time of operation in the field was embraced in the period between the sixteenth day of June and the twenty-seventh day of September—three and one half months in all. During this time the timber belt of Sonoma County, the Counties of Mendocino, Humboldt, Del Norte, and Trinity, and a small portion of Shasta County were visited. The maps submitted with my report show the forest-growths of this district, and material was furnished for preparing a map of Lake County, by Mr. Saml. Rice, County Surveyor, whose unremunerated service to the Board is herewith gratefully acknowledged.

The wording of the report might be at times misleading, the term "Coast Range" often being used without reservation.

This was generally done for brevity's sake, although the general character of the forests, save that it grows lighter as the Bay of San Francisco is approached, does not materially differ from that of portions covered by the report, which are correspondingly located in point of general topography. Notwithstanding this fact, the statements can, of course, be only strictly applied to the portions of the Coast Range actually visited.

Occasion is herewith taken to acknowledge the assistance rendered and the courtesy so universally shown to your Engineer while on his trip. To mention by name all those to whom he feels indebted for aid in his labors, would be a task more easily commenced than terminated.

Appendix C contains a list of a few of those who have especially contributed to make the report of value, and if occasion is taken to make special mention of their names, it is with the selfish motive of adding to the report the weight and authority which their acknowledged familiarity with the country cannot fail to carry with it.

The comprehensiveness of the method of inquiry directed by the Board must plead my excuse, if I have often been led into topics apparently outside the strict province of forestry; but the relations of agriculture and water supply stand so directly connected with forestry that the latter could not be comprehensively treated without some consideration of the others.

Respectfully submitted.

HUBERT VISCHER.

SAN FRANCISCO, November 6, 1886.

I.

INTRODUCTION.

General Character of the Coast Range.

Topographical and Hydrographical Features.

Necessity of, and Facilities for, Irrigation.

Summary Enumeration of the Zones of Tree Growths.

INTRODUCTORY REMARKS.

The Coast Range to the north of the Bay of San Francisco is a peculiarly dislocated complex of mountains, to briefly enumerate the salient points of which, some license in description must be granted. Its most characteristic feature is the double vertebræ which follows the line of the coast; and the law which is observed by the mountain chains, the rivers conform to also, flowing for long distances parallel with the coast before finding an outlet to the ocean.

It would indeed be difficult to instance another district of similar extent, and especially of such limited width, with so many watercourses of considerable length.

The topographical disposition, and the erosible character of the range, explains the deep-seated watercourses which form the main drainage arteries of the belt, as also their low rate of grade.

What the main streams lack in fall, their tributaries derive the advantage of, the whole country being divided up into long drawn ridges of considerable height, but no breadth, and the rivers being depressed into deep gorges, the secondary streams cannot be other than short, and their descent precipitous.

The most abundant of rainfalls, unless evenly distributed throughout the seasons, would fail to produce uniform conditions of flow in a water system like this, and it is but natural that the rivers should be torrents in the rainy season, and mere threads of running water in Summer. The Klamath River, just below the mouth of the Trinity, has been known to rise, after continuous rains, ninety odd feet, and during the Summer it is but an inconsiderable stream, which at points might almost be forded.

Indeed, it is questionable to what extent the rivers of the range might not be depleted in Summer, were it not for the influence of their high-lying sources, which are always more or less eked out by residual snows which hang on the highest peaks until late in the season.

It needs but the barest statement that there is but little room for extensive valleys in a range so cut up and broken: by which, however, is not implied that small valleys are not to be found at the heads of the rivers, or that bottom lands do not exist near their mouths.

The general trend of the coast, while in the main it runs north and south, has also a decidedly westerly element, and the ridges deviate even more from truly north and south lines. The whole system of ridge-chains and spurs consequently lies angling to the cardinal points of the compass. The prevailing storms come from the southeast and southwest. It will therefore be readily seen that hardly a divide or a spur exists but what presents varied exposures to both sun and wind, and it is equally evident that the sunny exposures are also the storm-swept ones, while the lee sides are those favored by shade. With these two elements intimately connected is both the accumulation of soil and the retention of snows. All the conditions

conducive to the growth of trees stand ranged together on the one hand, all those opposed to it are equally combined on the other; shade, shelter, soil, snow, as against all the elements that tend to produce arid and barren conditions.

Throughout the range the tree growths respond to these two opposed combinations, and to such a degree that the influence of altitude falls completely into the background as compared with that of exposure. This law holds good everywhere. Even in the densest forests of the redwood belt, the southern exposure always shows less fine timber, and is less heavily clothed than the one facing it—barring only such cases where, owing to local topographical configuration, the naturally sheltered slope chances to be the wind-swept one. Through all the gradations of arboreal development the difference can be traced; to open land succeeds brush; upon brush follows timber, and, as between timber growths, stand opposed lighter and heavier growths. Always with the sheltered, northerly (or easterly) exposure goes the higher state of growth, while the sunny, southerly (or westerly) slope shows a lower order of vegetation. The effect is so striking that whole sections of country will appear either well timbered or almost bald, according to the point from which they are viewed.

Equally important with the influence upon timber growth is that exerted by "exposure" upon springs and running water, and, of course, vegetation and aqueous supply are interdependent quantities.*

The Coast Range, generally speaking, notwithstanding its heavy annual rainfall, forms no exception to the general rule in California; it has a period of drought, or, at least scarcity of moisture during a certain period of the year. This, for the Coast Range, lasts say from the end of July until the first rains fall, about the end of September.

While it has been stated that the acreage of valley and bottom land in the range is but limited, much upland will be found, the soil of which is suitable for agriculture. Even though at present lying fallow, even though its suitability for crops may now be doubted, the time will come when these lands, under the influence of increased population and growing scarcity of fertile land, will be required for cultivation. Subject to late frosts, and with a rainy season lasting until well into May or June, agricultural operations can only be started late in the season, and the period in which crops must grow and mature is limited to a few months.

Owing to steepness of slope the upland arable lands are generally little adapted to holding moisture, and crops which are barely well started are caught by the drought, and though otherwise promising, fail to produce anything but insignificant yields. There are thousands of acres in the counties treated of in this report which would be highly suited to produce either fruit, vegetable, or grain crops could they but be supplied with even the most meager aid through irrigation at the proper time.

The agricultural development of the uplands of the Coast Range—and there is but little else but uplands—will be as dependent upon irrigation in time as are the lands of the southern portion of the State now.

Referring to our notes upon the general hydrographic conditions of the range, it may be inquired how can water be procured? The location of the main streams being depressed, and their grade slight, to bring water upon uplands would imply outlays which the value of the lands will never warrant; storage of water in the tributary streams and gulches cannot suc-

*No more striking illustration could be furnished of how dependent the supply of running water is upon exposure and timber growth, than in following the right bank of the Klamath River, to note how every ravine carries water as far down as Orleans Bar, while shortly after passing the bend of the river, all the short watercourses fail during Summer.

ceed, owing to the precipitous slope of their channels and the consequent lack of storage depth. Storage of water upon higher lying lands may, in special cases, succeed, but generally will be unfeasible, as the arable lands which it is sought to water are themselves in most cases situated at considerable elevations (upon flat ridge summits or upon the upper brow of slopes—it is only here that suitable soil deposits exist). Wells and the development of springs will be found like the last expedient, only applicable in exceptional cases.

Of all the means of storing water only one remains—nature's own means. It is only necessary to prolong the flow of the natural channels for a short period—a month or a fortnight would often suffice—and to accomplish this is within the power of being effected by stimulating tree growths upon very limited areas of ground, especially if due regard be had for impounding snow where practicable.

Well wooded as the Coast Range may be—and just how well wooded it is, an effort shall be made in the report to show—the aid of forestry may prove a matter of fully as much importance to a thorough development of the natural resources of the Coast Range as in other apparently more needy districts.

Although the maps accompanying the report give specific information as to the timber growths all over the range, and reference to the character of the timber at various points will be made in the paragraphs treating of the different trees, it is here deemed fit by way of introduction to sketch out in the broadest lines the character of the timber growths encountered:

a. Immediately along the coast shore, and outside the redwoods, brush growths and a growth of conifers of various kinds and of lesser economic importance.

b. The redwood belt, occupying the western slope of the outer backbone of the Coast Range.

c. Following the redwoods, a separate development of trees which are found in the redwood belt in conjunction with the redwood; zone of Douglas spruce, tanbark oak, chestnut, etc.

d. Belt of open wooded lands generally adapted to grazing or agriculture; oaks, yellow pine, and spruce.

e. Zone of coniferous trees of the Sierra Nevada; sugar pine, yellow pine, incense cedar, firs, and Douglas spruce.

f. The slope to the Sacramento Valley; belt of small pines and oaks.

II.

THE REDWOOD.

Description of the Belt; its Extent and Character.

Estimate of the Redwood Resource and the Redwood Cut.

The Efficiency of Redwood Logging and Manufacture, as an Art.

The Reproductive Capacity of the Redwood.

THE REDWOOD.

Sequoia Sempervirens.

DESCRIPTION OF THE BELT; ITS EXTENT AND CHARACTER.

As shown by the maps which accompany this report, the redwood belt extends from southern Sonoma County to within a few miles of the Oregon line, and though the tree seldom comes down to within a mile of the ocean, nor often crosses the outer coast divide, for purposes of rough characterization, the ridge summit and the shore line may be considered its limits on the east and west.

The term "belt," when used in connection with the redwood, is perhaps more strictly applicable than as applied to forest areas in general; nevertheless, it should simply be understood as designating the area within which more or less heavy growths of redwood occur, without implying either an exclusive or an uninterrupted development of this stately tree.

Throughout the belt a more or less considerable percentage of other trees will always be found interspersed with the redwood, and often completely displacing the latter.

In fact, in the more southern portions of the belt, the redwood is almost exclusively confined to the river bottoms and the cañon slopes for a very limited distance up their sides—this marked adherence of the tree to cañon bottoms and their immediate vicinity, at least as regards its heavier developments, being characteristic throughout the belt, but becoming less and less rigidly maintained the further north one goes.*

Starting in lower Sonoma County with mere filaments of redwood, the range of its development, even before passing into Mendocino County, is so much extended that sheltered slopes are clothed with redwood well up to their crests.

Proceeding further northward the areas clothed with redwood become ever more extended and the strictly belt-like character of the zone ever more pronounced. In southern Mendocino we already find a belt of timber, but the effective area of which is much reduced by extensive openings, either entirely bald or only clothed with brush.

Beyond the Noyo River, these openings cease or become so much reduced in extent as not to merit notice, and after passing the Ten Mile River, the belt becomes a continuous zone of timber, extending north to Indian Creek, which stream flowing east and west, nearly corresponds with the northerly line of Mendocino County.

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*The degree of steepness of slope seems in a high measure a determining feature; where the slopes are more than moderately steep the growth is seldom other than a scattered one, while flat benches and plateaus, even at considerable elevations—when not exposed to wind—are generally heavily clothed; a fact probably determined by the degree of thickness of soil deposit, as also the conditions of subsoil drainage. Altitudes as existing within the belt (say up to three thousand feet), seem hardly to be of much moment; the altitude to which the tree will grow being possibly determined by the snowfall more than anything else; places where snow lies to any considerable depth, or for any length of time, being seldom well covered with redwood.

At about this point the south fork of Eel River assumes considerable dimensions, and flowing nearly northward severs the outer range along its axis, into an outer and an inner half. The country near the coast drops in elevation, is drained by rivers flowing directly westward to the sea at right angles to the general trend of the watercourses of the range, and the country so drained is destitute of redwoods, the belt becoming interrupted for a distance of about twenty miles, save for isolated patches but a few square miles in extent, at most.

Redwoods first again appear in numbers on the streams which enter the coast immediately south of Humboldt Bay. These confluent streams, each carrying with it its separate body of redwoods, finally unite to form the large body which centers back of Eureka, and from which point a practically continuous belt of redwoods extends northward, within constantly narrowing lines however, through northern Humboldt and Del Norte, almost to the Oregon line.*

It thus appears that the redwood belt falls naturally into two divisions: a northern and a southern one. Each belt exhibits characteristics peculiar to itself and distinct from the other, differing in growth, development, and character of timber. For convenience in description they will be distinguished as the upper, northern, or Humboldt, and the lower, southern, or Mendocino redwoods, considering the term "Humboldt" generally typical for both Humboldt and Del Norte Counties, and "Mendocino" similarly characteristic of the belt both in that county and Sonoma.

In mere point of development of individual trees, or even of enormous yield of lumber on exceptionally densely covered tracts, no very great contrast presents itself between the two belts. In southern Sonoma County, trees quite as large existed, and isolated acres stood fully as heavily timbered as anything which can be found near the northern limits of the belt. In point of general denseness of growth, however, the Humboldt belt surpasses that of Mendocino.†

The leading points of distinction between the two belts may be summarized as follows:

For the lower belt, more broken country, steeper slopes, and generally higher ridges than in the upper belt; also a markedly drier climate, and generally more direct exposure to heavy winds. As the result of these conditions, less soft and mellow timber and a smaller percentage of timber clear of knots‡; generally closer grained timber, of slower growth; timber inferior for internal finish, though more serviceable, perhaps, where exposure to alternate dry and moist influences is to be anticipated.

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*The headwaters of Dominie Creek may be considered the practical northern limit of the belt, above which point the growth is very scattered. Redwoods exist in Oregon, but merely as representatives of the species.

†I am indebted to J. W. Bagley, C.E., of Guerneville, for interesting figures, both as to the size of trees and yields of redwood lumber near that formerly famous vicinity. Mr. Bagley measured one tree 349 feet 9 inches in height, and another 19 feet in diameter underneath the bark, and states that the yield of one measured acre scaled in milled lumber 1,431,530 feet, board measure.

‡As regards percentages of clear—a point upon which so much stress has been laid—the figures for the Gualala Mill Company were 34 per cent in 1884, 30.2 per cent in 1885, while the mills of northern Mendocino produce from 45 to 50 per cent of clear. As high as 70 and 80 per cent is claimed by some of the mills around Mad River, although 60 per cent appears about an average percentage for the Humboldt Bay mills generally. The Crescent City and Smith River mills claim only 20 to 25 per cent of clear. These figures are, of course, only of relative value, the percentage of clear greatly depending upon the price and demand for rough lumber at the time; in other words, how close the lumber is worked for clear stuff. In comparing Gualala with the Humboldt mills, it is to be remembered that the former mill is working over land from which much of its choicest lumber has been cut, whereas the Humboldt mills are all still logging from bottom lands. Twenty years from now their percentage of clear will probably have considerably fallen from what it now is.

In the lower belt, greater restriction of redwood to cañon bottoms and lower hillsides, with but sparse representation on the summits, the slopes, as one ascends, running into Douglas spruce and tanbark oak; consequently a greater percentage of foreign trees for the southern than for the northern belt. Lastly, a diversity in the general disposition of the redwood growth upon the ground, indicating different habits of the tree and varying peculiarities of growth and development, to which subject some reference will be made later on.

From the general description of the redwood belt it will be clearly understood that even within the limits of what must be designated as essentially redwood lands, great variations prevail in density of growth, as determined by location and exposure, apart from the universal disparity which exists in all forests; the heavier growth being confined to certain spots, while those immediately adjacent are practically barren.

Much has been written as to the phenominal timber yields of redwood lands. The yield is in reality unparalleled. Yet fully commensurate with the yield is its shrinkage before reaching the market.

To those conversant with logging operations, the numerous causes of shrinkage in actual production are familiar subjects; to the uninitiated their enumeration (and their number is legion) would be of little interest. Less so, perhaps, the answer to the question: what portion of the standing tree is represented by the product measured at the tail end of the mill? From the best data obtainable, we may place the ratio of product to raw material in the standing tree as about $28\frac{2}{3}$ per cent, or say that for each foot of manufactured lumber leaving the mill, $3\frac{1}{2}$ feet of lumber in the tree is consumed.*

These figures sufficiently establish the fact that the proportion of lumber produced to what might be a fair estimate of the quantities standing in the tree is disproportionately small, and when taken in conjunction with the by no means small percentage of lands capable of producing but nominal yields, leads naturally to the adoption of conservative standards upon which to base estimates of the resource represented by our timber belt. The results of actual milling experience, whenever obtainable, show comparatively modest figures—in relation to which it should also be remembered that the lands so far cut over have always been lands above the average, both in point of density of growth and facilities for successful logging, and that the record of past performances can hardly be a true gauge for the results of a decade hence. Throughout the belt, lands capable of furnishing exceptional yields are always found, but they are no criterion of what the belt taken as a whole is apt to produce.

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*This figure is of interest, having a practical bearing upon other subjects. Its method of determination is here given in some detail as answering a question which has been often asked, but which, I believe, never satisfactorily answered.

The percentage of standing tree (in the column alone; not counting limbs), directly left unutilized in top and stump .... 25 per cent.
(20 to 25 per cent is a generally conceded figure. Some measurements actually made by me, on several trees, would place this item at nearer 30 per cent.)
The loss through breakage in falling, loss of wood burnt accidentally in swamping, allowance for chance rotten spots, and other causes of loss before reaching mill .... 10 per cent.
Leaving it assumable that there reaches the mill, in the shape of logs .... 65 per cent.

Moreover, the percentage of log convertible into lumber, by Spaulding's Scale (assuming them round and perfect logs), is $0.505 \div 0.785 = 63$ per cent.

And the corrective coefficient to render Spaulding's Scale applicable to redwood logs, 70 per cent. (Determined by J. W. Henderson, of Eureka, as the result of actual comparison on several thousand logs actually tested.)

This gives for the net yield, $0.65 \times 0.63 \times 0.70 = 28\frac{66}{100}$ per cent, or conversely, $1 \div 0.28\frac{2}{3} = 3.48$ for the ratio of wood in the standing tree to the actual output of mill.

THE REDWOOD RESOURCE AND THE REDWOOD CUT.

THE RESOURCE.

To clearly define the lands so far cut over and cleared of timber, would, in most parts of the belt be impossible, its exterior lines differing to-day but little from what they were when the lumberman first commenced operations. Proceeding along the streams, always taking what was most accessible and selecting the best lands, the belt has been honey-combed, but little reduced in absolute area. Here and there, where the mills have clustered very thick, strips might be segregated from the body and classed as cleared; but generally speaking, to attempt to show in map form the extent to which exploitation has been carried, would fail; either conveying an exaggeration or an understatement of the facts, according as lands only partially worked over were embraced in or totally excluded from the clearings. That the attacks upon the belt have not been insignificant, may be inferred by the distance from which logs are often transported to the mills. The Mendocino Lumber Company's advanced logging camps are twenty-nine miles from the mill (by water), and the Albion Mill draws its logs about nineteen miles, of which four and one half miles by rail, in two stretches, with fourteen miles of intermediate water transportation. Higher lying lands have been little drawn upon as yet, save for supplies of ties, posts, shake-bolts and the like split material. Here the settler working his own timber has effected wholesale destruction with his frow and ax, chosing only the most promising trees and utilizing but the freest-splitting portions of these, and often leaving the tree entire waste, if its grain proved refractory or its texture "flinty." The waste has been enormous.

Various attempts have been made to determine the timber resources of the belt. The best of these—that made by Mr. John Dolbeer and submitted to Col. R. S. Williamson, United States Engineer Corps, in 1880—certainly possesses the merit that it embodies the ideas of many of the prominent mill owners along the coast, which entitles it to consideration. This estimate has been already published in several official publications, and it is given below, should an interest be found in comparing it with the estimate now submitted to the Board.*

*Estimate of John Dolbeer, Esq. (of Dolbeer & Carson), of the amount of redwood standing, 1881. (From a letter addressed to Col. R. S. Williamson, United States Engineer Corps, *dated March 15, 1880*):

From Russian River to Cottonavia Creek	7,680,000,000
From Cottanavia Creek to Eel River	50,000,000
On Eel River and tributaries	5,000,000,000
On Humboldt Bay	1,920,000,000
On Little River and Mad River	4,000,000,000
From Little River to Big Lagoon	2,500,000,000
On Redwood Creek and tributaries	2,500,000,000
On Klamath River and around Crescent City	----------
Total	23,650,000,000

Mr. Dolbeer also estimates the consumption of redwood at:

Sawed lumber	120,000,000
Railroad ties	30,000,000
Posts	9,000,000
Shingles and shakes	12,000,000
Total	171,000,000

This estimate bears also, in indorsement of it, the signatures of the Mendocino Lumber

The lumber resource concentrated in the redwood belt being the most important in the State, both on account of its magnitude and accessibility, and probably quite equaling in productive power of merchantable lumber at least that of all the balance of the State combined, accurate information concerning its extent, character, and probable duration was considered of importance to the Board of Forestry. The defining lines of the belt have never been traced before with any attempt at detail, nor the effective area of redwood land determined, save by rough approximations, based upon assumed widths of the belt, the results of which approximations never failing to leave the impression that the estimate above referred to stated but a fraction of what the belt might be relied on to produce.

The actual resource will, as a matter of course, never be known, save as an approximation, and the figures submitted only claim consideration above those made by others, inasmuch as they were made on the ground, with a correct knowledge, at least, of the area of the belt (to determine which the special knowledge of almost every local surveyor was drawn upon), the experience of the mills and their actual performances utilized, wherever determinable; and no known source of information was left unconsulted that might serve to determine the special character of the belt at its different points. For this information the views of professional timber experts, owners, surveyors, and assessing officers were gathered by personal consultation, aided generally by township plats which were at hand.

That to raise information drawn from so many and such different sources above the level of mere compilation, the writer's personal views could not fail to materially color the whole, is evident. The figures are believed to be conservative, and care was taken to be within rather than above the actual facts. For this no excuse is pleaded, experience having well established the fact that few professional timber experts ever set figures low enough to meet the actual yields when practically tested; and the fact has not been lost sight of that our average present practice utilizes considerably less than one third of the standing tree, not taking account of timber too defective to be suitable for cutting, or which, when cut, is unfit to go to mill.

Together with the yields given first by natural subdivisions (similar to the estimate of Mr. Dolbeer), and afterwards by counties, are added the acreage of what was considered effective redwood land, even though sparsely clothed. Figures are also given showing the range between which the bases upon which the partial estimates never covering more than a few thousand acres at the outside (and not shown in the report) were made; also the acreage of lands whose yields were considered nominal, and which must be taken into consideration in criticising the *average yield* per acre for the different counties (which was simply obtained by dividing the total yield by the effective total acreage) which, from the explanation first made in this subdivision of the report has, to a great degree, been affected by the influence of the portions of the belt already cut, and perceptibly also by the consideration that while no portion of the belt can be to-day considered inaccessible, *i. e.*, too inaccessible to be stripped of timber eventually, still highlying and outlying tracts will be hardly likely ever to yield the fair quota which they might be expected to produce if otherwise located; their method of stripping promising to be either effected by less economical methods, or at least coupled with greater care in selecting and taking

Company; H. B. Tichnor & Co., of the Navarro Mill; J. G. Jackson, of the Caspar Mill; S. H. Harmon, of the Gualala Mill; F. P. & J. A. Hooper, of the Trinidad Mill Company; J. Kentfield & Co., Eureka; J. Russ & Co., Eureka; McPherson & Wetherbee, of the Noyo and Albion Mills.

to the mill only the best timber, than would be the case were they more accessible and capable of being logged at less expense. These reservations and exceptions alone excepted, the figures are designed to cover the whole redwood resource of the belt.

The resource as first presented is subsequently modified by deduction for portions of the total cut not allowed for in the original calculation, and after deducting which the residual quantities present for the different counties the resource as it may be considered at present.

TABLE A.

Estimate of Standing Redwood in Del Norte, Humboldt, Mendocino, and Sonoma Counties.

1. Locality—County.	2. Acres of Effective Redwood Land.	3. Estimated Capacity subject to Correction for amt. cut (see Column 7). Ft. Board Measure.	4. Average Yield per Acre; Column 3 Divided by Column 2.	5. Acres Sparsely Clothed with Redwood 15,000 Feet per Acre and under.	6. Range. Yield Used in Partial Estimates (not shown). Minimum.	6. Range. Maximum.	7. Portion of Estimated total Cut to be deducted from Column 3. (See Table B.)	8. Estimated present amount of Standing Redwood. Feet Board Measure.
North of Smith River	29,565	519,825,000						
Smith River to Klamath River	56,604	2,096,342,000						
Del Norte County	(86,169) say 86,000	2,616,167,000	30,362	30,720	5,000	60,000	61,150,000	2,555,017,000
Klamath River to Mad River	208,699	7,549,261,000						
Mad River to Van Dusen River	143,460	5,719,950,000						
South of Van Dusen River to Mendocino County line	92,491	3,994,642,000						
Humboldt County	(444,653) say 444,600	17,263,853,000	38,830	62,000	15,000	125,000	1,112,000,000	16,151,853,000
From Humboldt County line to Ten-Mile River	142,414	3,972,420,000						
Ten-Mile River to Big River	147,731	4,431,930,000						
Big River to Gualala River	139,696	3,890,880,000						
Mendocino County	(429,841) say 429,800	(12,295,230,000) say 12,295,000,000	28,600	72,400	15,000	50,000	1,343,000,000	10.952,000,000
Sonoma County	41,700	980,000,000	23,500	11,200	10,000	45,000	140,000,000	840,000,000
	1,002,100	33,155,020,000		176,320			2,656,150,000	30,498,870,000

RESUME.

Total acreage of redwood lands	1,002,100
Deduct lands very sparsely clothed	176,300
Acreage of good and fair lands	825,800
Total standing estimated amount of redwood, feet board measure	30,498,870,000

THE REDWOOD CUT.

Records of the quantity of redwood taken from the belt exist only in the most fragmentary and disconnected form, and are not sufficient to determine the cut with precision. However, utilizing all the data which diligent search unearthed; from records where they existed, from the best traditionary evidence where no records could be procured, it would appear that the following statement may not be far astray: *

TABLE B.

Estimated Total Cut of Redwood to date in Northern Redwood Belt.

County.	Lumber Sawed by Mills. Ft., Board Measure.	Shingles. Reduced to Ft., Bd. Measure.	Posts. Reduced to Ft., Bd. Measure.	R. R. Ties. Reduced to Ft., Bd. Measure.	Total Estimated Cut.	Cut from Belt, as defined in Estimate. Correction used in Table A, Col. 7.
Del Norte	59,400,000	1,750,000	------------	------------	61,150,000	61,150,000
Humboldt	1,416,000,000	83,250,000	35,000,000	32,000,000	1,566,250,000	1,112,100,000
Mendocino	1,424,000,000	56,000,000	52,000,000	224,000,000	1,756,000,000	1,343,000,000
Sonoma	697,000,000	42,000,000	18,000,000	64,000,000	821,000,000	140,000,000
	3,596,400,000	183,000,000	105,000,000	320,000,000		
Total					4,204,400,000	

The total estimated cut has been figured out as 4,204,400,000 feet, which, if all the wood used for shakes to build settlers' improvements (and which never have shown up in any records) were included, allowing for the waste such use always is accompanied with, would probably swell the total cut from the upper belt to at least 5,000,000,000 feet of lumber, or its equivalent.

As has been stated, no record of the cut was kept in the earlier years of redwood lumber operations. We are, however, thanks to Mr. E. L. Allen (Secretary Redwood Manufacturers' Association) enabled to furnish figures covering the estimated production of sawed lumber for five years back, which may serve to illustrate the tendency towards increase which the market is developing.

* Statements of the quota which each mill had furnished (as well as might be now determined) were obtained; the output of old dismantled mills determined by information gathered on the ground from persons conversant with the mills and their markets in years past. Such items as ties, shingles, and posts were arrived at by estimating the consumption, as indicated by the best preserved records, the same data, when covering several years, supplying the means of approximating the percentage furnished by each county, from which the final distribution was made. The items have been kept separate, to court corrections, if better information exists in some unknown quarter.

TABLE C.

Showing the Total Estimated Consumption of Redwood Lumber for the five years, 1881–1885.

Year.	Production. Feet, Board Measure.	Increase. Feet, Board Measure.	Decrease. Feet, Board Measure.	Per cent.	Remarks.
1881..	130,465,714	....	....	......	Does not include Santa Cruz and adjacent counties; local consumption.
1882..	152,517,738	22,052,024	....	$14\frac{5}{10}$	Does not include Santa Cruz and adjacent counties; local consumption.
1883..	250,000,000	72,482,265	....	$\frac{32}{100}$	Includes Santa Cruz and adjacent counties. In this year Southern California took 72,000,000 feet. Santa Cruz and adjacent counties consumed 25,000,000. Apart from these items the consumption was virtually steady.
1884..	208,455,000	....	41,545,000	$16\frac{2}{3}$	During this year shipments to Southern California dropped off to 35,000 and Santa Cruz' consumption is stated at only 3,000,000 feet. Independent of the influence of Santa Cruz and Southern California, consumption increased 11 per cent.
1885..	215,000,000	6,545,000	....	$3\frac{1}{7}$	

The table shows that apart from the shipments to Southern California and the Santa Cruz consumption, both of which appear to have fluctuated widely, the tendency has always been upward and the increase considerable; the average annual percentage of increase having been seven and one quarter per cent.

Records of the consumption of the San Francisco market, and that of points directly drawing their supply from San Francisco (for sawed lumber alone), have been systematically kept since 1863. These figures are added, as also such fragmentary memoranda as are at hand, concerning the production of lumber of the several counties, and which may serve to throw some light upon the development of the redwood market.

TABLE D.

Embodying past records of production for various parts of the belt; showing the consumption of Redwood Lumber by the San Francisco markets, and shipments to foreign ports.

YEAR.	Consumption of San Francisco Market—Sawed Lumber only. Ft. Bd. Measure.	Del Norte County.	Humboldt County. Sawed Lumber.	Mendocino County.	Sonoma County.	Foreign Shipments.
1860			9,575,000			
1863	43,022,597					
1864	41,591,177					
1865	53,097,753					
1866	60,174,310		[1]27,648,000 [2]34,961,916			
1867	66,665,954					
1868	84,754,183					
1869	81,899,095					
1870	87,706,213		[1]27,648,000 [2]34,977,700			
1871	75,295,952					
1872	89,782,618					
1873	73,870,244		[2]50,764,224			
1874	95,545,490					
1875	110,231,073					
1876	113,011,014					
1877	107,330,749					
1878	92,327,814					
1879	88,121,653					
1880	80,731,664					
1881	93,565,989					[1]7,000,000
1882	94,606,063					
1883	103,195,515	[1]4,262,740	[1]79,815,646	[1]77,905,717	[1]18,948,459	[1]10,000,000
1884	103,941,105					[1]17,000,000
1885	115,253,922	4,050,000	82,300,000	74,050,000	4,400,000	[3]10,200,000
Total	1,955,722,147					

1. Sawed lumber. 2. Including shingles, ties, and posts, but not local sales of sawed lumber. 3. Shipments:

To Mexico, Central, and South America	950,000
To Islands of the Pacific	2,650,000
To Australia	5,950,000
To Europe	650,000

THE ANNUAL CONSUMPTION OF REDWOOD AND PROBABLE DURATION OF THE BELT.

The figures shown in Table C warrant one in assuming that the prospective consumption of sawed lumber will hardly fall short of that of the year 1885, say 215,000,000, to which in estimating the total consumption must be added the production of the sundry items other than sawed lumber, and which may be stated to run, one year taken with the other, about as follows:

Railroad ties—equivalent in feet board measure	*15,000,000
Posts	†12,000,000
Shingles and shakes	12,000,000
	39,000,000
Making, with the consumption in sawed lumber	215,000,000
A total of (feet board measure)	254,000,000

And if these figures are a correct gauge of the future, the duration of the redwood might be set at about one hundred and twenty years.

What its duration will eventually prove, is a matter difficult to predict, the consumption being materially influenced by several modifying causes and the relation between supply and demand not altogether a simple one, at least as regards the home market.

To the creation and development of outside markets it is, however, that one must mainly look for material increase in the redwood cut, and the attention of our redwood manufacturers is largely directed towards developing new fields outside of the home market. Drying houses, to render the lumber capable of cheaper transportation, are being introduced; railroads having direct connection with transcontinental roads (and which will open to exploitation portions of the belt now virgin), promise to be constructed within the near future. The intrinsic merits of redwood lumber, when thoroughly appreciated abroad, and the rapid exhaustion of the timber resources of the Eastern States, are other causes promising a considerable increase in the annual cut of redwood.

As regards the home market, the increase will, for a time at least, be probably only that due to the increase in population and accumulated wealth of the State. The redwood has always been a relatively high priced wood; its cost of production (delivered in San Francisco), generally having been above that which pine (Douglas spruce) lumber, shipped from Oregon and Washington Territory, could be sold for, and the consumption of redwood has always more or less been gauged by the ratio of its market price to that of other lumbers; the uses to which redwood was applied somewhat varying with its price.

The aggregate productive capacity of the mills has always been approximately twice the actual output; the absorptive capacity of the home mar-

* This item was set by Mr. Dolbeer at 30,000,000 feet. Our figure it is believed fully covers the present average annual consumption in ties, but a few years hence Mr. Dolbeer's figures are liable to be nearer correct. From the mileage of railroad track equipped with redwood ties, and of which a major portion has been built less than twelve years (which is the average life of redwood ties), one may assume that the consumption for repairs alone will, a decade hence, have reached Mr. Dolbeer's figure. We leave it, however, at 15,000,000.

† The posts received in San Francisco in 1884 were 1,794,000, which at 14 feet board measure per post, equals 25,116,000 feet board measure.

The posts received in San Francisco in 1885 were 893,000, which at 14 feet board measure per post, equals 12,502,000 feet board measure.

We take the lowest figure, say 12,000,000, as the average consumption.

ket for building lumber of all kinds more than double that of the redwood consumed—but the balance of cost of production is always against redwood and in favor of other woods. Under these conditions constant over-production has prevailed, and only through combination has a market been sustained at all. A valuable resource—purely Californian, the real value of which will only be known when the resource is nearly exhausted—is rapidly melting away, and going, too, without adequate return to the financial prosperity of the State. New mills are being constantly added to the already more than abundantly sufficient number, and amelioration of the condition of the industry is mainly to be expected from foreign demand.

As an offset, however, to the causes tending to decrease the duration of the belt, as gauged by the present cut, the promise exists of a more conservative spirit appearing, as the redwood becomes scarcer and centralization of ownership into a few hands renders control of the market possible, when redwood may be considered too choice a wood for many of its present purposes. These tendencies and the higher efficiency in productive methods which higher prices are liable to bring in their train, may tend to prolong the life of the redwood a few years beyond the period which, under the influences tending to increased consumption, it might otherwise be reduced to.

At a rough guess, everything considered, the redwood is not liable to be exhausted in less than seventy-five to eighty years; nor does it promise to last much more than a century.

THE EFFICIENCY OF REDWOOD LOGGING AND MANUFACTURE AS AN ART.

The term "efficiency," as we shall have occasion to use it in connection with logging or manufacture, may be defined as *the percentage of raw material in the standing tree converted into some commercially valuable product.*

To go into details and attempt a description of the peculiarities of redwood logging and manufacture as at present conducted, interesting and worthy of notice as the subject in itself is, would lead us from issues of forestry into matters of mainly technological interest. We can only attempt to briefly notice such points as have a material bearing in shortening or prolonging the life of the redwood belt as a forestal resource, which is only another term for "efficiency," as above defined.

The amount of waste made in redwood manufacture has been already noticed as something enormous, being, according to the general average present practice, as well as we have been able to approximate it, a fraction over 71 per cent.

Perhaps never clearly defined as a mathematical ratio before, the fact has always been patent that only a small portion of the raw material in the tree found its way into marketable products, and insensibly perhaps the inference drawn that this was all more or less chargeable to the inefficient methods of the manufacturer.

Closely considered, it will be found that he is responsible only for a very small portion of this large shrinkage. As might be presumed *a priori* the lumberman has ever been concerned to produce as much clear product as possible from the raw material handled, within the limit of reaping the largest possible return upon invested capital; he has exercised that degree of economy which the general conditions under which he has labored admitted of, and it is due to his efforts solely that year by year the standard of efficiency of his art has crept up gradually from the lower standard that it was to the standard of to-day, which is no longer a low one, when gauged by the probable limit which he may hardly ever expect to surpass. If we are right in setting the present efficiency at about 28 per cent, there is equally good reason for believing that in the infancy of the lumbering art the efficiency was hardly more than 20 per cent, and it may be pretty confidently asserted that the extreme limit of efficiency which he may ever hope to attain will not exceed 40 per cent, unless time and increasing scarcity of lumber should develop a demand for portions of the tree at present unmerchantable.*

The proposition has been dryly stated; yet nude figures best serve to correctly define the present state of the art, and also, which is of equal importance, to establish conclusively the fact that mere increase in efficaciousness in manufacturers' methods can only hope to extend the duration of the redwood belt to a limited degree.

To show how slow the march of progress is, let us—still adhering for awhile to dry figures—consider to what extent the introduction of the

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* Not to overload our subject with dry figures we omit a demonstration of these ratios. Their proof is, however, given in Appendix A.

bandsaw, one of the most radical changes ever proposed in manufacturer's methods, in connection with the redwood, may be expected to raise the present standard of efficiency. The bandsaws now used (by a few of the more progressive mills only), makes a curf (cut) of about $\frac{1}{12}$ of an inch. The curf of the large circular saws is about $\frac{3}{8}$ of an inch. The difference between the two saws is immense ($\frac{3}{8} \div \frac{1}{12} = 4\frac{1}{2}$), and if this were a true gauge of the saving effected in actual practice, there might, indeed, be cause for congratulation. With saws making $\frac{3}{8}$ inch curf, the percentage of sawdust made, may, under extreme conditions, amount to over 40 per cent of the lumber sawed. In actual practice, the sawdust generally made (sawing lumber, thick and thin, to meet the call of the market as the demand usually runs—using "pony" and other saws in conjunction with the circulars), may not exceed 25 per cent of the lumber sawed. The bandsaw, used to the extent to which it is usually proposed to apply it, may reduce the amount of sawdust made about 50 per cent. The lumber made by circular saws being, say $28\frac{2}{3}$ per cent of the raw material in the tree, we have for the average percentage of tree converted into sawdust 25 per cent of $28\frac{2}{3}$ per cent $= 7\frac{1}{6}$ per cent, and by bandsaws 50 per cent of $7\frac{1}{6}$ per cent $= 3\frac{1}{2}$ per cent (about), which would make the efficiency of manufacture by bandsaws, $28\frac{2}{3} + 3\frac{1}{2} =$ say 32 per cent.*

In whatever there may be cause to lay the charge of wasteful methods and ruthless sacrifice of timber to the lumberman's door, it may be well to remember that for the unknown redwood a market had to be created, and that to subjugate these giants, special methods had to be devised. Small wonder that, in the hands of novice workmen, trees 300 tons in weight (without counting limbs or boughs), proved tough subjects, or that single logs of 35 (yes, not seldom 60) tons were weighty things to handle, and that to dissect them much hacking were required. When carefully considered, to merely move such weights must have been a problem of no small difficulty, and with the primitive appliances of pioneer days it must indeed have taxed to a high degree the resources even of an ingenious class. Beset by difficulties such as these, no wonder that waste was great. Step by step progress has been made—at first slow, afterwards more rapid; new appliance after new appliance was introduced; new schemes and new wrinkles devised, until to-day redwood lumbering has become what it now is—an art in itself. A resource, which in those days, in a State but thinly settled, appeared exhaustless as the ocean, has gradually attained to partial recognition. The day is coming when the raw material in the tree will be considered capital, and as such, husbanded and guarded. To-day its value in the raw state is nominal, its price in the market determined by cost of production mainly—timber lands still being held at but nominal figures, available timber lands constantly changing hands at prices corresponding to not over 20 cents per 1,000 feet of lumber capable of extraction. This figure may at present fairly represent (probably more than represents) the intrinsic value of the "nettable" redwood in the raw.†

*This, we know, is not putting the facts in the most favorable light for the bandsaws. We by no means wish to imply that bandsaws may not increase the net yield of lumber from any given log, by say $12\frac{1}{2}$ per cent, which is quite in conformity with our other figures. We have seen some of the finest and most even lumber anywhere inspected, cut by bandsaws, and we heartily hope to see them universally introduced. Since railroad logging superseded water transportation, no such promising step has been made as the proposed introduction of the bandsaw.

† Stumpage ranging from \$1 to \$2 per 1,000 feet at the outside has been paid for years past, it is true. Yet whether this figure can be considered as having ever represented anything but the premium arising out of the greater accessibility of certain spots on which the lumber chanced to stand is questionable. In past years, at least, where stumpage was paid it may safely be considered as having only been as an offset against reduced transportation charges.

Let the past remain what it was. At present the whole tendency throughout the belt is towards economy. As timber lands are becoming scarce and hard to obtain, their timber is becoming prized. The mills of to-day are revelations to the novice, and there are many at which no end of pains is taken to promote the small economies. Mill after mill emulates another in devising new specialties of manufacture whereby waste odds and ends of lumber, which formerly went to the waste pile and were burnt, now are worked into shape to fill some useful purpose. Grape boxes are now made of redwood, the sides and bottoms of which formerly would have been burnt—the ends have to be made of choice lumber. Shingles and shakes formerly either split or sawed from bolts selected from the best of timber, now are very generally sawed from outside slabs, otherwise refuse. Pickets, likewise, and short lengths of board (three and four feet and upwards), which formerly would have received no notice, are sawed into even lengths, tied in packages, and shipped to market as "panel stuff."

These items, all small in themselves, and probably in bulk but increasing the percentage of raw material utilized to a very small degree, still show the drift of the times; as at the mill, so also in the logging camp the set tendency is towards care.

To-day, so far as the redwood—*at least*—is concerned, there can be little just charge of needless waste. With woods of other trees the matter stands far differently. The Douglas pine meets some slight grace, to the extent of being cut and utilized when of good quality—the chestnut oak is stripped of its bark at least, even though the wood go to waste. As to the other trees, they go, not by the steel but by fire;—burnt at the root, scorched in the bark, they wither and die—remaining standing for a time, until they fall to pieces from rot, or robbed of their natural shelter, they are blown over by the winds. Much to be regretted as this may be, the reason why these woods are going to waste without any attempt being made to utilize them, is simply that under the present conditions there is no demand for them at prices which will pay to manufacture them into lumber. The supply of other more desirable woods is so great, and the price of them so little above their cost of production, that inferior woods, however good in themselves, are excluded from market.

THE REPRODUCTIVE CAPACITY OF THE REDWOOD.

Our investigation of the acreage of the redwood belt, and the timber resource contained in the same, naturally led to large figures, but also establishes the fact that even at the present rate of consumption no very great number of years will elapse before the resource will be exhausted. This naturally suggests the inquiry: "To what extent may an aftergrowth be relied on as a means of restocking the belt, and what period would be required to develop trees suitable for profitable sawing?"

The conclusion which has forced itself upon the writer, after careful survey of the ground, is that to no considerable extent is an aftergrowth of redwood to be expected at all. The conviction, amounting to certainty in the writer's mind, is, that although the redwood, as a species, will probably never die out entirely, it is never likely to attain to heavy development again, and that practically speaking, the present resource is all that can be counted on.

In mere point of power to successfully resist the hardest treatment which the elements can subject it to, no tree can surpass the redwood; nor, as simply characterizing this peculiar capacity, could its botanical name have been more fitly selected, yet the writer has failed to find the first acre of cleared ground which promised to become a growth of trees worthy of the name, even where fires had been kept out and the location was a sheltered one. Opinions differing with this view have been frequently asserted and found expression in official publications, which should be authoritative, yet it is believed that mere power of resisting destruction has been confounded with the widely different one—the power of reproduction.

Before attempting to ground this view, it may be as well, however, to consider some of the typical forms under which the tree is found growing in nature. We note what we consider the types, as also such inferences as to age and manner of growth as observation suggests:

Type 1. Trees of mammoth size, thickly aggregated, yet uniformly distributed over the surface. Long clear shafts. Trees characteristically healthy looking, and foliage well developed—so thickly often as to exclude the sun's rays, save when the sun is near the zenith. Ground clear from all underbrush, fernbrake at most covering the ground; but more often, where the growth is very dense, nothing but a carpet of leaves. Now and again the shafts show fire marks on bark; burnt and charred stumps, however, phenomenally absent; complete absence of all trees of young growth, or even growth differing much from the general uniform standard, and no foreign woods at all.

This type characterizes flats and river bottoms—especially streams tributary to Eel River, and generally the heavily timbered bottoms of Humboldt County and Del Norte.

Type 1 is eminently suggestive of primeval growth; no vestiges of an older growth being anywhere discernable. Probably developed from seed.

Type 2. Trees also uniformly distributed, and an apparent growth from seed, but size generally only moderate, and not colossal; distribution open and scattered, often collected in groups, but not in a manner indicating an aftergrowth from a common source. Trees of slower growth than in type 1, but probably of not less age; characteristically the growth of the

lower (Mendocino) belt, corresponding to type 1 further north. Young trees rarely common; but foreign families well represented, especially on sidehills, where the redwood is more strung out.

Type 3. Trees often of great size, and individually often as fine specimens as those of type 1, although more often trees of only moderate height. Differs from types 1 and 2 purely in point of trees being always or at least, characteristically close clustered in groups, often around one central tree of greater age than the rest; oftener the parent tree destroyed and only the charred stump remaining. Always so distributed, however, as to suggest a secondary growth, not from seed but a sucker growth. Type 3 especially common in southern Humboldt, south of Garberville, where the Humboldt belt comes in.

Type 4. Trees evenly distributed, but growth generally thick. Trees of all sizes intermixed—from saplings up to well matured trees, the younger trees characteristically tall and slender. Specimens 4 to 6 inches in diameter are often 70 to 80 feet high, with no foliage save near the tops, the whole energies of the young trees being centered in attaining height and sunlight. This growth is a scarce one, and only characteristic in spots from Little River (Humboldt County), north, to the Klamath River, but especially near Prairie Creek. Foreign woods (Douglas and Menzies spruce and White fir) well interspersed with the redwood. Type 4 is the solitary instance of a redwood forest in course of natural replenishment; trees of all ages growing in the same forest occur often mixed with type 3.

Type 5. Trees thickly aggregated, yet not clustered; *of uniform size and young growth.* Evidently a young and new forest sprung up spontaneously from seed. A very rare growth, only noted on low and moist lands. Can be seen well developed on road from Crescent City to Smith's River Corners. Young hemlock well represented with the redwood growth.

These have been given as types, and localities even mentioned. That the different types merge and run into one another is self-understood, and often within a few miles of one another several of the types will be seen. More frequently, however, a combination of two or sometimes three types will characterize a considerable district.

Of the five types enumerated, two (they are uncommon ones, by the bye) show the growth of young trees progressing before our eyes, and a third suggests, at least, the growth of a secondary forest by sucker growth; and all three might be instanced in support of the probability of our belt restocking itself as the present growth is being cut out.

There is no question but that forests have grown and passed away, and been succeeded by new forests, and this may have been going on for ages.*

However, whatever the redwood may have done in the seclusion of its natural haunts, under the lee and shelter of standing timber—consequently under the same conditions that standing trees flourish under—it may fare widely otherwise with it under such conditions as it probably will be subjected to in the clearings left by the logger. It is often urged that time sufficient has not elapsed to warrant the expectation of finding trees of any size as yet. This is quite true, and it is not that young redwood trees of fair size cannot be instanced at all; it is rather because they

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* That the redwood is a tree of immense age is unquestionable, excavations often unearthing specimens of redwood at very considerable depths. The writer has in his possession two samples of redwood taken from a tunnel run through "Table Bluff" (near Eureka), both in a state of excellent preservation, the one having been encountered 550 feet, the other 800 feet, from the nearest tunnel ends, and both at a depth of 200 feet below the surface. This is but another instance of the wonderful durability which the tree, or at least certain portions of it, reveals.

can be found grown to fair size (say up to 20 inches in diameter and 60 to 70 feet in height, which even now might furnish timber for some purposes) *but only as cases of rare exception*, that there appears so little promise of any considerable aftergrowth succeeding our present forests. One may hunt over many acres of logged ground and not find one of these promising specimens. For the rest, where the logged grounds are left uncared for, one finds thousands of sprouts and suckers clustering about the old stumps and their more immediate vicinity (smothered generally among underbrush), but nowhere showing promise of a widespread and a uniform growth, if even a slow one.

What artificial protection and care might do towards fostering an aftergrowth there is no means of determining, but it is safe to say that the generally prevailing conditions throughout the belt are not likely to be those of fostering care. Whatever aftergrowth is developed will probably be under direct exposure to the sweep of the storm, and probably exposed also to the periodical visits of fire, enough in themselves to check all development.

It is, however, not necessary to obtrude personal views to establish the point that little is to be expected from future growths of redwood. We may go to the living tree to determine what growth might, under the most favorable circumstances, be expected (say from the saplings now started) by the time our present supply promises to be exhausted, from which we may judge whether, practically speaking, there are grounds to warrant us in placing much reliance on the future growth.

It may be stated in general terms that, as one proceeds northward in the belt, the growth of the redwood—for trees grown under relatively similar conditions—becomes constantly more rapid up to the point where the tree gives out. In Mendocino County 300 rings can often be counted upon logs 30 inches in diameter, while in the vicinity of Smith River we have notes of measurements made on two trees, the one with a diameter of 5 feet 10 inches, showing 189 annual rings (length of tree unknown), the other, of which we have fuller measurements, with a diameter of nearly 6 feet (measured 9 feet above the ground), showing 214 rings. Both these trees are of phenomenally rapid growth. The measurements made upon the second tree are given in tabular form in Table E:

TABLE E.

Illustrating the Growth of Redwood on Smith's River, Del Norte County.

A. Measurements upon butt log, 9 feet above surface of ground.

Age of tree—years.	The tree had attained a radius—*i. e.*, distance from heart to bark of—feet.	Growth—increase in semi-diameter.	Interval—years.	Rate of growth per year in one-thousandths feet.	Remarks.
30	0.46	0.46	30	15⅓	214 annual growths, maximum radius, 2.95 feet; minimum radius, 2.53 feet. Heart wood.
40	0.59	0.13	10	13	
60	0.97	0.38	20	19	
70	1.20	0.23	10	23	
80	1.42	0.22	10	22	
90	1.61	0.19	10	19	
100	1.79	0.18	10	18	
110	1.93	0.14	10	14	
120	2.05	0.12	10	12	
130	2.12	0.07	10	7	
140	2.18	0.06	10	6	
150	2.24	0.06	10	6	
160	2.29	0.05	10	5	
170	2.34	0.05	10	5	
180	2.39	0.05	10	5	
190	2.44	0.05	10	5	Semi-sap wood.
200	2.495	0.055	10	5½	
210	2.535	0.04	10	4	Sap wood.
214	2.57	0.035	4	8¾	
------------	------------	2.57	214	------------	

Miscellaneous Memoranda.

NOTE.—*Measurements, 79 feet from butt cut* (*i. e.* 79+9=88 feet from ground); maximum diameter, 4½ feet; minimum diameter, 3.9 feet.

Measurements, 96 feet above butt cut, or 105 feet above ground; maximum diameter, 3.7; minimum diameter, 3.6 feet. At this cut, wood bleached and light red in color. At 106 feet, first protruding knot was observed.

At 112 feet 9 inches from butt cut (*121 feet 9 inches from ground*); maximum diameter, 3.35 feet; minimum diameter, 3.25. (Between this section and the following, timber knotty.)

B. Record of Ring Measurements 129 feet 3 inches above butt cut, or 138 feet 3 inches above ground.

Age of tree—years.	Radius—feet.	Growth—feet.	Period—years.	Average annual growth in one-thousandths feet.	Remarks.
0	------------	------------	------------	------------	Heart wood.
10	0.21	0.21	10	21	
20	0.40	0.19	10	19	
30	0.57	0.17	10	17	
40	0.73	0.16	10	16	
50	0.86	0.13	10	13	
60	0.97	0.11	10	11	
70	1.09	0.12	10	12	
80	1.21	0.12	10	12	
90	1.25	0.04	10	4	
100	1.29	0.04	10	4	
103	1.30	0.01	3	3⅓	
155	1.42	0.12	52	2⅖	Sap wood.
------------	------------	1.42	155	------------	

Miscellaneous Memoranda.

Above this point 77 feet of knotty lengths and 20 feet of broken fragments, the last still 5 inches = 0.42 feet diameter, or 0.21 feet radius, representing say 10 to 15 feet of growth

lacking, which would make the height the tree had attained when cut 129′ 3″ + 97′ = 226′ 3″ + 15 feet (estimated) = 241 feet, or in all 250 feet from ground.

DEDUCTIONS FROM ABOVE DATA.

Height of tree, say 250 feet; age when cut, 214 years; average linear growth, $\frac{250}{214} = 1.166$ feet.

Comparison of Tables A and B.

Age of butt-log section (Table A)	214 years.
Age of section (Table B)	155 years.
Difference	59 years.

By reference to Table A, we see that at 60 years the tree had attained a radius of 0.97 feet, or a diameter of say 1.94=2 feet, practically speaking. This tree would scale (by log scale) 855 feet, board measure, assuming the tree to have been one foot thick at 60 feet from base, and that it furnished logs up to that height. The tree at 214 years (as the logs lay on the ground) scaled a yield of 13,391 feet, board measure.

The average annual yield in lumber for the tree up to 60 years of age is therefore $\frac{855}{60} = 14\frac{25}{100}$ feet board measure, while that for the tree when cut (214 years old) was $\frac{13391}{214} = 62\frac{58}{100}$ feet, board measure. From which it is easily seen that as a producer of lumber the tree at 214 years of age had produced $(62.58 \div 14.25 =) 4\frac{4}{10}$ times as much lumber for each year of its growth as it had done previous to its attaining its sixtieth year, disregarding the difference in quality of the lumber produced.*

These figures illustrate how important a factor age is, where the production of wood in quantity is the object. Where quality is sought, the same superiority in favor of older growths, up to the age of maturity, is always observable, and this applies not to the redwood only, but to trees in general. In fact we have the assurance of Baron von Muller that the eucalyptus even cannot be relied upon to yield timber fit for sound plank under fifty years.

Where the production of shade and the development of leaf surface are the prime desiderata, the importance of tree planting cannot be overstated, yet the fact should not be lost sight of that forests such as at present adorn and characterize our State cannot be reproduced by forced growth. They are the work of nature operating through ages; they are the survivors among the hosts which have perished. To reproduce them is no work for man, and, once gone, who shall see their like again?

In making estimates of the probable duration of the present stock of redwood, it was stated that the supply could hardly be counted upon to last more than a century. Judging from the records contained in subdivisions A and B of Table E, at the age of one hundred years, the tree to which these measurements refer would have attained considerable dimensions, say a diameter of 3 feet 7 inches, nine feet from the ground by 18 inches at a height of one hundred and thirty-eight feet. This tree, which would scale 5,723 feet (by $\frac{3}{4}$ log scale) and which would probably produce 4,000 feet under the saw, would be by no means beneath the notice of lumbermen, especially in an exhausted belt, and, were the growth recorded in Table E an ordinary one, might really attest to trees attaining sufficient size within a century to make them valuable for lumber. It has, however, been already stated that growths like that of this special tree are exceptional; lower in the belt there are places where trees three times the age of this one would not have attained to similar size.

These are the facts, and they are recommended to the special consideration of those who have prophesied bright things for the future redwood. All things considered, there is no tree which exhibits such wonderful ability to resist destruction, but which promises less for a second growth:

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*It may be claimed that the standard of comparison selected, *the capacity for yield of lumber* has been an unfair one for the young tree; that the efficiency should have been gauged by the quantity of wood annually produced. This places the matter, however, in a light but little more favorable for the young tree. Similar calculations based upon the mere wood producing capacity of the two trees give for the average annual production of the young tree $2080 \div 60 = 34\frac{67}{100}$ feet, board measure, and for the tree at 214 years of age, $25647 \div 214 = 120$ feet, or for the relative efficiency of the older tree above the younger one $120 \div 34.67 = 3.45$ (as against $4\frac{4}{10}$).

At an early stage in my investigations my attention was directed by as old a woodsman as Mr. R. B. Markle, of Westport, to the scarcity of redwood trees growing from seed. The point raised, my attention was constantly directed to obtaining a specimen which had unquestionably been produced by other than a growth directly secondary to, and demonstrably connected with an older growth. No pains was spared to investigate promising looking saplings, but never once was one found growing under what might be called normal conditions. Growths under abnormal circumstances were often instanced, and there can be no question but that the tree is capable of reproducing itself by seed. Forest-growths, like those described as types 1, 2, 4, and 5, can hardly have been produced in any other manner, beside the fact that there are points in the range where outlying patches of redwood trees (often several miles apart), now and then a few acres in extent, and again only in groups of a dozen trees, extend inland from the belt proper for considerable distances. These isolated patches—interesting developments in themselves—can hardly have sprung up otherwise than from seed.

Many persons assure me that seedlings are common, but when attempting to show them on the ground have always failed to do so. My own experience was that of Mr. A. H. Hooper, of Crescent City, who assures me that he has hunted the woods for several years with the express purpose of procuring seedlings and not succeeded in finding a solitary specimen.

The writer wishes here simply to note his own experience. Whether to be found or not, the seedlings certainly form but a very small percentage of the young growing trees, and the redwood—although possessing the ability to do so—certainly shows a marked disinclination to propagate itself otherwise than by a root growth.

The subject has no unimportant bearing upon the propagation of the tree, and may in itself explain the cause of the redwood being so narrowly confined to certain zones. This has always been attributed to the redwood's inability to flourish save within the limits of prevalent and heavy fogs, and its close restriction to a peculiar character of soil. (See F. B. Hough's excellent report on forestry to the Commissioner of Agriculture, 1878: "It grows only on underlying metamorphic sandstone, and does not thrive in other formations"). Neither of these statements tally with the writer's observations. The redwood may be found in flourishing state growing upon every soil, marine or volcanic, in the range. It grows on sandstone; it grows on talcose schists, and mica schists; it grows on granite, and, unless the writer is much deceived, he has seen one of the outlying patches of trees above referred to, standing upon a bed of serpentine, the redwood here growing among yellow pines and sugar pines; at least the country for miles around was serpentine, and no signs of a foreign formation suggested their presence. As to its close restriction to fog-swept belts, one of the finest developments which the redwood attains anywhere, that of the South Fork of Eel River, is in a district practically exempt from fogs. Heavy "dripping" fogs are unknown, or are of very rare occurrence, although river mists are common. A certain amount of atmospheric moisture is probably essential, and a very dry climate would probably be unsuitable to the redwood. The one striking peculiarity of the South Fork redwood is its development of exceptionally luxuriant foliage, which may, perhaps, be in consequence of an extra stock of leaves being required to fulfill the functions of the tree.

The writer believes the following facts go far towards proving that soil is of less moment to the tree than is generally believed, and that it in a great measure draws its nutriment from atmospheric sources. An excellent specimen has been noted growing upon rocky ledges, from the roots of which all soil had been stripped, only one far-reaching root still preserving any communication at all with the soil, its other roots hugging the bare rock and protruding out over the precipice.

Another curious instance noted was that of a fallen tree, of which a section had been sawed out, and the upper portions left completely removed from all connection with the roots. Here the branches, four in number, had righted themselves, and assuming an erect position developed into well-formed saplings, the largest fully twenty-five feet high and four inches in diameter.

No excuse is offered for presenting these facts in some detail. They may, if the writer be correct, suggest an adaptability of the tree to a wider range of conditions than the restricting influences above noted would imply. Much has been written upon the redwood, its habits, and peculiarities, and much misconception still prevails.

III.

TREES OF THE COAST RANGE OTHER THAN REDWOOD.

1. The Quantity of Standing Timber other than Redwood; the Present Resource; the Prospective Cut.
2. The Douglas Spruce.
3. The Yellow Pine.
4. The Sugar Pine.
5. The Cedars.
6. The Menzies Spruce.
7. The Firs.
8. The Oaks.
9. Miscellaneous Woods.

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Remarks.

the redwood belt and its immediate vicinity. See map. 335,000,000
-d in column 14, being inside of redwood belt.

Mertensiana). [2]Not included in column 14, being in redwood belt and
orded in column 2.
14, for reasons above.

mber for Trinity falls out high, not because timber is superior, but
s for the home market, and the standard is low; but for this local con-
,000,000 would have been classed as unfit for sawing.

Remarks.

r, and *Pinus Muricata*. [3] Estimate only applies to redwood belt and
ls foreign timber besides redwood.
lso, *P. Contorta* and white fir. § Average high on account of timber
estimate, but not standing on acreage recorded in column 2.
cords; *Ceanothus*, *Pinus Tuberculata*, and scrub oak. Sundries: 270,-
nquapin, maple, ash, etc.
oplar, laurel, maple, and chinquapin. *P. Contorta*, *P. Tuberculata*, and

ly; classed with oak and madroña, column 10.

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TABLE F. APPROXIMATE ESTIMATE OF TIMBER AND CORDWOOD (OTHER THAN REDWOOD), FOR SONOMA (PARTIAL), MENDOCINO, HUMBOLDT, DEL NORTE AND TRINITY COUNTIES

A. *Estimate of Saw Lumber (fit for domestic purposes, at least, if not for export). (Feet Board Measure)*

County	1 Number of Acres in County	2 Acres classed as Timber Land in Estimate and not included in Redwood Belt	3 Douglas Spruce (Oregon Pine) Pseudotsuga Douglasii Total	4 Douglas Spruce (Oregon Pine) Total outside of Redwood Belt	5 Yellow Pine (P. Ponderosa)	6 Sugar Pine (P. Lambertiana)	7 Cedar of Lebanon (Libocedrus decurrens and Chamæcyparis Nutkaensis, Cupressus fragrans (Kelloggii))	8 Cedar Port Orford Cedar (Chamæcyparis Lawsoniana)	9 Menzies' Spruce (Abies Sitchensis), Sitka Spruce	10 Oaks and Madroña	11 Sundries. Small (scrub) Oaks and Brush Woods (See Remarks)	12 Firs. White Fir Abies (Picea) Grandis, Silver Firs, Magnifica and Nobilis	13 Sabin Pine (P. Sabiniana)	14 Total (columns 4 to 13 inclusive)	15 Average Number Cords per Acre (Column 14 and Column 14, Table A, reduced to cords*), Divided by Column 2)	16 Tanbark Oak (Cords Bark)	Remarks
Sonoma	900,000	118,000	335,000,000	.	.	....		.	..	Classed as Cordwood			Classed as Cordwood.	.	18		Estimate only applies to the redwood belt and its immediate vicinity. See map. 335,000,000 feet Oregon pine not entered in column 14, being inside of redwood belt
Mendocino	2,280,000	320,000	5,100,000,000	1,080,000,000	530,000,000	Nominal	Nominal	.			--			1,010,000,000	[illegible]		
Humboldt	2,020,000	400,000	2,570,000,000	1,070,000,000	900,000,000	75,000,000	25,000,000		20,000,000		‡‡(130,000,000)	†(330,000,000)		2,390,000,000	90		† Hemlock spruce (*Tsuga Mertensiana*). ²Not included in column 14, being in redwood belt and not on the 400,000 acres recorded in column 2.
Del Norte	190,000	207,000	1,235,000,000	800,000,000	302,000,000	90,000,000	25,000,000	²(2,000,000)	(1,275,000,000)			285,000,000		1,571,000,000	[illegible]		Not included in column 14, for reasons above.
Trinity	1,080,000	630,000	1,230,000,000	1,200,000,000	2,919,000,000	762,000,000	395,000,000	..				744,000,000		‖6,118,000,000	[illegible]		‖ The estimate for saw lumber for Trinity falls out high, not because timber is superior, but because all lumber sawed is for the home market and the standard is low, but for this local consideration most of the 6,118,000,000 would have been classed as unfit for sawing.
Total estimate of saw lumber (feet board measure)			10,500,000,000	4,225,000,000	4,711,000,000	927,000,000	415,000,000	.	20,000,000			1,029,000,000	..	11,130,000,000	.		

B. *Estimate of Cordwood (i. e. all lumber not fit for being sawed) and consequently classed as Fuel. (Cords.)*

County	1 Number of Acres in County	2 Acres classed as Timber Land in Estimate and not included in Redwood Belt	3 Douglas Spruce (Oregon Pine) Pseudotsuga Douglasii Total	4 Douglas Spruce (Oregon Pine) Total outside of Redwood Belt	5 Yellow Pine (P. Ponderosa)	6 Sugar Pine (P. Lambertiana)	7 Cedar of Lebanon (Libocedrus decurrens) and Chamæcyparis Nutkaensis, Cupressus fragrans (Kelloggii)	8 Cedar Port Orford Cedar (Chamæcyparis Lawsoniana)	9 Menzies' Spruce (Abies Sitchensis) (Sitka Spruce)	10 Oaks and Madroña	11 Sundries. Small (scrub) Oaks and Brush Woods (See Remarks)	12 Firs. White Firs, Abies (Picea) Grandis, Silver Firs, Magnifica and Nobilis	13 Sabin Pine (P. Sabiniana)	14 Total (columns 4 to 13 inclusive)	15 Average Number Cords per Acre (Column 14 and Column 14, Table A (reduced to cords*), Divided by Column 2)	16 Tanbark Oak (Cords Bark)	Remarks
Sonoma	900,000	118,000	All timber in redwood belt classed as saw lumber or disregarded	450,000		..	.	...	Classed as Saw Lumber	1,173,000	†103,000	...	...	1,760,000	*18	97,000	† Sundries: Laurel, alder and *Pinus Muricata*. * Estimate only applies to redwood belt and immediate vicinity; 18 cords foreign timber besides redwood.
Mendocino	2,280,000	420,000		5,700,000	1,600,000	³Nominal	.	..		1,030,000	‡1,400,000		Nominal	13,790,000	§18¾	277,000	‡ Sundries: As above, also *P. Contorta* and white fir. § Average high on account of timber in redwood belt included in estimate, but not standing on acreage recorded in column 2.
Humboldt	2,030,000	400,000		9,630,000	1,800,000	60,000	75,000			5,400,000	¶2,370,000		.	10,335,000	91	393,000	¶ Brush woods, 2,100,000 cords, *Ceanothus*, *Pinus Tuberculata*, and scrub oak. Sundries: 270,000 laurel, poplar, alder, chinquapin, maple, ash, etc.
Del Norte	580,000	207,000		3,280,000	724,000	62,000	75,000	.		1,880,000	217,000	285,000		6,533,000	[illegible]	106,000	Sundries: Alder, ash, poplar, laurel, maple, and chinquapin. *P. Contorta*, *P. Tuberculata* and *P. Monticola* (?).
Trinity	1,080,000	630,000		2,332,000	6,710,000	567,000	1,017,000	.....		4,430,000	††	457,000	226,000	15,785,000	[illegible]	Nominal	†† Not regarded separately, classed with oak and madroña, column 10.
Total estimate of cordwood (i. e. wood unfit for saw lumber)				21,452,000	10,890,000	689,000	1,167,000			18,923,000	3,150,000	742,000	226,000	57,220,000	....		

* NOTE.—1 cord of standing wood = 1,000 feet (board measure). 1 cord = 128 cubic feet; 128 × 12 = 1,536 feet (board measure) × 0.63 (sawing coefficient) = 967 feet, or say 1,000 feet.

THE QUANTITY OF STANDING TIMBER OTHER THAN REDWOOD; THE TOTAL PRESENT RESOURCE; THE PROSPECTIVE CUT.

Material existed for arriving at very fair conclusions as to the extent of the redwood resource, and the estimate submitted in this report is believed to be a fair approximation to the true quantities of standing timber. Redwood has now been a subject of practical study for thirty years and over, and much information has been stored. Professional experting has become an occupation in itself, and the actual performances of the mills can often be determined with fair accuracy. Operations have been conducted upon an extensive scale, the method of working, moreover, making a pretty clean sweep as it progresses; and sufficiently large tracts have been denuded to furnish data suitable for extended application, furnishing average figures, which tests of more limited scope would lack.

As regards other woods, matters stand far otherwise; experience fails and records are generally lacking. Here and there a figure of dubious accuracy may be found, but for the most part everything becomes more or less guesswork. Regarding the Douglas spruce, at least within the limits of the redwood belt, some fairly reliable information can be obtained; also, now and again, concerning the yields of tanbark oak a figure can be got at. Generally speaking, however, the records are very meager. Other woods than these just cited have little commercial value at present, and but little attention has ever been paid to them. They are simply regarded as so much useless material, pure incumbrances clogging the lumberman's progress. The redwood belt has also the great advantage over other forests, that within the limits covered by redwood, redwood growth greatly predominates, and is, above all, continuous; attention can be pretty well centered upon the essential elements.

In our other forests things become much more complicated. There is, first of all, some little difficulty in determining just what is timbered land and what is not, the gradations are so gradual between the heaviest growths and open ground merely studded with trees. The number of families, moreover, usually increases; their degree of representation constantly changes; their size and quality, and also the capacity of lumber yield for trees of apparently the same size but of different families, differs so much that estimates worthy of being termed anything more than guesses can only result from detailed examinations which are laborious and time-robbing operations. Long continued practice, even, is not always a guarantee of accuracy, as opportunity to test results is wanting. Estimating timber is and remains to a great extent guesswork. With the majority of "timber sharps," their performances are but guesses at first and remain guesses to the last. Careful work and close attention, of course, accomplish much in this line, as in all others, but much time and patience are required to hit anywhere near the mark.

These remarks are ventured, as perhaps not entirely out of place, while

submitting Table F, which is intended to be an "approximate estimate" of the amount of timber other than redwood in the counties which this report covers. They are not mere random figures, but are based upon numerous and constant attempts to cover the difficult ground they purport to cover. They are at least the outcome of much counting of the number of trees on estimated acreages, rough calculations of the yield of individual trees, noting of the percentages of trees of different families, and the relative number of acres covered by trees of the same kind, in different portions of the same counties. How far the observer has been correct in his observations, how far his application of data from known ground to districts not passed over has been a judicious one, he hopes future experience may throw some light upon; that others may find an interest in testing and making known the result of their observations. Care has been taken to leave the different items of the calculation open to easy inspection, criticism being earnestly courted. Only continued observation can hope to lead to correct results and guard against erroneous deductions which are worse than total ignorance.

The table presents its contents in the form of exact figures, reduced to feet and cords. This was considered the only suitable form of presenting the estimate, as original data—records of percentage and the like—would probably have conveyed little information to others than the preparer of the table. A specific disclaimer is here made of any desire to imply greater accuracy on account of the number of numeral places filled by figures other than cyphers, and which might just as well have been replaced by zeros; the figures are simply the results of the calculations by which they were determined, but slightly rounded off.

Whatever the deficiencies are, however, the "estimate" in a way covers ground upon which there is no other data, and, for lack of anything better, may within reasonable limits be considered correct. In a broad way, it probably covers the ground for which we intend to use it fairly well, and, used with some degree of caution, may not lead us very much astray.

The estimate contains two tables, respectively headed: "Fit for Saw Lumber" and "Cord Wood." As regards the use of these terms, some explanation is necessary:

Firstly—The estimate in nowise purports to cover *all* standing timber; young growths, say of twenty to twenty-five years and under, having been entirely disregarded, nor is it designed to cover "brush," ordinarily speaking. The words "brush woods," heading column 11, refer purely to matured growths of scrubby timber or the larger shrubs, such as are well adapted for fuel and are at present used as such, and that not merely by chance settlers, but such as really find a ready sale and have an established (if only a local) market.

Secondly—It should be stated that after passing out of the redwood belt timber of prime quality becomes exceedingly scarce. Numerous ailments affect the woods (some of which will be hereafter noticed). For local home consumption there is a sufficient supply, often of choice timber, now and again bodies extensive enough to possibly warrant the erection of mills of moderate size, where the timber is accessible. Generally speaking, however, if these belts are ever exploited for anything other than home consumption, it will only be at a time when our available supplies of choice lumber are so far exhausted that we must perforce utilize lumber which now would find no sale in the San Francisco market. The classification under the headings, "saw-lumber, for local purposes, at least," and "fit for cordwood," is simply an attempt to separate that which would be con-

sidered locally fit for sawing from that which is really not fit for lumber at all, and is by no means meant to imply its probable ultimate use for fuel, or even its fitness for such, when the wood is generically poor fuel wood. The criterion as to what was fit for saw-lumber, and what not, was simply present *local* practice, and consequently the standard of classification was a varying one. Of the final total quantity in Table A, more than one half is assigned to Trinity County, simply because the standard lumber of the Trinity County mills is low.* On the other hand, although much of our oak wood cut is suitable for use for better purposes, it is generally used for fuel, and it has all been classed as cordwood in consequence. Of the total 11,630,000,000 feet classed as saw-lumber, probably not one third would find sale in the markets of San Francisco, at least not as first or even second rate lumber.†

Let the restrictions regarding *quality* drop, accessibility presents itself next in order. How much of this 12,000,000,000 feet (say) could ever be got out of the country? Much of the best of it growing at altitudes of between 4,000 and 7,000 feet, shut up in the most broken mountain range of California, even could it be brought to the main streams, how get it successfully to their mouths? We call attention again to the topography of the range and the character of its rivers (see introduction). Rivers 150 to 200 miles to where they enter the sea, with average falls of 10 to 15 feet per mile; set with rapids: torrents in the rainy season, and fordable creeks in mid-Summer and Autumn. Let all restrictions fall: in mere point of quantity, how far will 12,000,000,000 feet of lumber go to supply a market whose present annual consumption, local and foreign, is between 400,000,000 and 450,000,000 feet?

We may utilize the data in Table F for another purpose. We may profitably compare the quantities estimated therein—regarding them as mere quantities of timber—with the resources in the redwood belt. Some modification of both quantities is necessary before they can be fairly compared.

Referring to Table A (see page 143), our redwood belt was estimated as capable of producing 30,478,870,000 feet of merchantable lumber or its equivalent; this with an efficiency of $28\frac{4}{7}$ per cent—that is, each one foot of lumber representing three and a half feet of wood standing in the tree.

This only refers to the sound lumber fit for cutting (not more than ordinarily affected with rot, nor liable to extraordinary wastage in falling), nor does it include the younger redwood timber, under say twenty inches diameter, usually used for "skids," etc., and not sent to the mills at all. Taking consideration of these two items, we may safely say that each foot of manufactured lumber represents an equivalent of four feet (instead of three and a half) in the standing forest, so that substituting for the redwood resource, in capacity to produce merchantable lumber its mere equivalent in wood, we have, for comparison with table F:

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* Yellow pine boards, with from one to a dozen knots, twisty in grain, and sure to curl and warp out of shape in the sun, find ready sale at good prices, as does also cedar lumber, which is riddled with rot.

† That the scarcity of good lumber for even local use is not exaggerated in the interior of the range, is proved by the fact that mills of only 2,000 to 3,000 feet daily capacity, and running from three to four months in the year, after a few years have to get their logs several miles away from the mills, not cutting off the timber by any means, but only culling out the small portions fit for use.

4 × 30,478,870,000, or 121,915,480,000 feet as the true standard of comparison.

Reducing the two quantities in Table F to one item, we have:

57,239,000 cords @ 1 cord = to 1,000 feet board measure	57,239,000,000
Saw lumber	11,630,000,000
Total	68,869,000,000

Besides the redwood there are other woods which can be as safely predicted as sure to be destroyed in course of time as the redwood itself, either being directly associated with the redwood and doomed to go with it, or else equally sure to go from other causes now in operation, not speculative and possible causes of removal. We refer only to the cutting of tanbark oak and the clearing of certain lands. These timber quantities then fall under the same head as the redwood, "doomed timber," and fall away from the quantity in Table F.

Not to refine *ad infinitum*, these items have been collected, and grouped by counties, are as follows:

Sonoma County, feet B. M.		491,000,000
Mendocino County		2,049,000,000
Humboldt County { Cleared for timber	3,335,000,000	4,685,000,000
Humboldt County { Clearing arable lands	1,350,000,000	
Del Norte County		752,000,000
Total		7,977,000,000

We have then,	
Timber Doomed—redwood	121,915,480,000
Plus as above stated	7,977,000,000
(A) Total	129,892,480,000
Table F—reduced to feet, board measure	68,869,000,000
Less, as above stated	7,977,000,000
(B) Balance	60,892,000,000

That is to say, granting Table F to be a true exhibit of the facts, the timber which, in the direct future, is sure to go on the immediate coast is more than double all the fair standing timber in the five counties put together, apart from that which will be cut, and leaving out of consideration all new growth.

Table A is based upon an average of from 35 to 48 cords of standing timber per acre, outside of the redwood belt (see column 15), which is our estimate, and is believed to be high enough, one acre taken with another. Admitted (for sake of argument), however, that our estimate is too small by half; that we should have gauged the standing averages twice as high (70 to 96 cords per acre, which would certainly be beyond the facts), still the standing timber of fair dimensions would not equal that destroyed by the time the redwood is cut out. Go still further, double this again, if desired. Place upon all the timbered acreage shown in column 2 of Table F, average yields of 150 to 200 cords per acre (which would be preposterous), and matters still remain unpromising.

The extent to which forests influence climate will never be so thoroughly determined as to warrant the prediction of the results of forest destruction with certainty. That an important influence does exist, however, few will now deny. Well wooded as the Coast Range at present is, the amount of its forest lands which promise to be divested of timber may well cause grounds for apprehension.

THE DOUGLAS SPRUCE.

(Pseudo-Tsuga [Abies] Douglasii).

[*Locally known in the four coast counties as "red fir" and "yellow fir"; in Trinity County as "spruce."*]

Second only to the redwood, in point of value and extent of its lumber product, is the Douglas spruce, its lumber, generally sold as "Oregon pine," being too well known to need more than passing notice. Suffice it to say that as a complementary wood to the redwood, it fills all the deficiencies which the latter may show, and, taken in conjunction with it, the two trees fill almost all the varied requirements of the building trade. Where the redwood is deficient it excels; and its shortcomings the redwood makes good. Without being by any means one of the hard woods, firmness of texture and great elasticity characterize the wood to a marked degree: and its peculiar capacity for furnishing long spars of straight-grained and sound timber (free from objectionable knots, at least.) renders it peculiarly valuable for many purposes of construction. For many uses in finishing work, flooring, and the like, it is highly adapted, provided the wood is properly sawed, so as only to present what is technically known as vertical grain: otherwise, being a stringy wood, with hard, flinty, pitchy winter-growths, somewhat loosely bound together by the softer summer-tissues, it splinters badly, and, under abrading influences, goes rapidly to pieces.

No tree presents so extensive a range of growth, and, as John Muir observes,* "it is not particular in its choice of soil—wet or dry, smooth or rocky, it makes out to live well upon them all." While among trees a perfect Bohemian, flourishing under the most varying conditions of climate and exposure, it is by no means always the same tree, and even in outward habit differs widely according to whether its lot falls in pleasant lines or hard ones. To commence, although botanically identical—or at

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*In his delightfully written paper (The Coniferous Forests of the Sierra Nevada), published in the *Century*, Vol. XXII.

For a gracefully penned description of the tree we can not do better than to quote from Mr. Muir. Of the Douglas spruce in the Sierra Nevadas he writes:

This tree is the king of the spruces, as the sugar pine is king of pines. It is by far the most majestic *abies* I ever beheld in any forest. One of the largest and longest-lived of the giants that flourish throughout the main pine zone, often attaining a height of nearly two hundred feet, and a diameter of six or seven. Where the growth is not too close, the strong and spreading branches come more than half way down the trunk, and then are hung with innumerable slender swaying sprays, that are handsomely feathered with the short leaves which radiate at right angles all round them. This vigorous spruce is ever beautiful, welcoming the mountain winds and the snow as well as the mellow summer light, and maintaining its youthful freshness undiminished from century to century through a thousand storms.

It makes its finest appearance in the months of June or July. The rich, brown buds with which all its sprays are tipped, swell and break about this time, revealing the young leaves, which at first are bright yellow, making the tree appear as if covered with gay blossoms; while the pendulous bracted cones with their shell-like scales are a constant adornment.

The young trees are mostly gathered into beautiful family groups, each sapling exquisitely symmetrical. The primary branches are whorled regularly around the axis, generally in fives, while each is draped with long, feathery sprays, that descend in curves as free and as finely drawn as those of falling water.

No other tree seems so capable of adapting itself to earthquake taluses, and many of these rough bowlder slopes are occupied by it almost exclusively, especially in Yosemite gorges moistened by the spray of water falls.

least not distinguished from one another—two distinct varieties exist as regards color and general peculiarities of the wood, and the lumberman, in places where both varieties occur, never fails to distinguish the *red* from the *yellow fir*. Of the two varieties, although often growing side by side, it may generally be said, that the so called *yellow fir* affects the more immediate vicinity of the coast (say the outer fifty miles of the range), while the *red fir* predominates further inland. Whether the distinction can be carried further than a mere "lumber classification," is questionable, and even here the two varieties shade off more or less into one another. Experienced woodsmen claim to be able to distinguish the varieties by the appearance of the bark and the shape of the shaft, yet it is believed that, in many cases, only the axe determines the proper classification as red or yellow. It is certain, however, that the distinction is not a purely arbitrary one, at least as regards the wood, although it might not be altogether simple to define the differences sharply and to enumerate them concisely. Color is first of all a distinguishing feature. The one variety is light in shade, from its faintly colored sapwood to its darker shaded core, the tinge being decidedly yellow, often verging upon saffron. The red fir, on the contrary, after passing out of the well defined sapwood (which is seldom more than four inches thick), is distinctly reddish in hue, the tint suggested verging upon a light cherry, rather than any other red. The wood of the "yellow fir" (we preserve the terms for convenience of description, although the tree is not a fir at all), is mellower than the red fir, and—though according to its growth, the wood may be fine grained or coarse—it always shows a marked difference between its summer and winter tissues; whereas, the red fir (at least far inland), is so close grained as to present a uniformly hard surface, which polishes when dressed. The yellow variety, when properly handled, is often a finishing lumber, easily worked; * whereas, the *red* is essentially flinty, and little suited for carpenter work of the finer kinds. Long lengths of clear timber entirely free from knots are common in the yellow fir, while the red fir is apt to be full of pin knots, which, however, are firmly interwoven in the other fibers of the wood, and are not apt to fall out, being almost pure pitch wood and very compact in texture. Where the knots are only small, they may hardly be said to affect the serviceability of the wood.

If the writer has mastered a lesson in woodsman's lore, and correctly distinguishes the two varieties, he would describe the external characteristics as follows: The yellow fir shows coarse, thick bark, heavily water-furrowed, and the trees are generally heavier bodied and heavier limbed, besides showing more sweeping foliage than the red fir, which is apt to be very slender, with a trunk but little tapered and bark characteristically smooth. The bark of the yellow fir is seldom darker than a rich brown sepia, or when taking a purplish cast the hue is neutral tint; that of the red variety is almost black, and its foliage more pendulous and of a richer green tint than that of the yellow fir.†

While the Douglas spruce, as has been said, appears almost all over the Coast Range, wherever heavier tree growths are to be found, the character of the tree and the quality of its wood varies greatly, according to exposure. The great bulk of the valuable timber will be found among the redwoods, and immediately back of the belt. Here the trees protected

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*Good shakes are often split from the yellow fir.

† As caution is advisable in treading ground not too well sounded, it is freely admitted that in this characterization points of distinction may have been taken as characteristic, which in reality were only casual and the result of local conditions.

from the direct sweep of the winds grow to fine size, clear of limb to considerable heights, and sturdy in trunk, and the tree is possibly the handsomest tree in the forest, fully bearing out Mr. Muir's description, save that here the foliage is more sweeping than strictly pendulous. While capable of withstanding wind and storm, the tree loses its noble proportions under exposure, the limbs then growing down so as almost to sweep the ground and the whole airy character of the tree disappearing. Altitudes up to five, and even six thousand feet, at least, seem to affect it but slightly. Some of its finest developments, say to trees eight feet and more in diameter and two hundred and fifty feet in height, may be observed high up in the Siskiyou Range. Yet, as the county becomes more openly timbered and the climate hotter, the tree hunts shelter more persistently, and in Trinity County becomes almost purely a cañon growth. Comparatively stunted and squatty on the exposed ridges, when found there at all (though always a large tree), under the lee of sheltering hills, it shoots up straight to a line, with shafts which taper but little as they become lost in the whorls of foliage, which often only first appear one hundred feet and more from the ground. On the south fork of the Trinity River the development becomes particularly imposing and beautiful. Here the foliage often droops and hangs in matted festoons about the trunk as nowhere else in the range, and the sprays have been observed ten and even fifteen feet in length, drooping perpendicularly from the limbs so gracefully pendulous as only to suggest comparison with a sheet of falling water. Here the name Pseudo-Tsuga first strikes one as being well chosen, and cursorily observed, the resemblance to the finest types of hemlock-spruce is for the moment misleading.

Exposure which tends to mar the external symmetry of the tree also impairs its value as a producer of fine timber. Wherever much exposed to winds, even where the trunk is fairly well sheltered, the tree becomes "wind shaken," and logs are apt to show much checking, which impairs the soundness of the wood. In addition to this, in the drier parts of the belt a species of white rot affects the Douglas spruce to a great extent, and its wood when so affected is valueless, being in woodsman's parlance "conkesy." Save for a looseness of the bark here and there, or a white spot showing itself occasionally on the trunk, nothing may indicate its diseased condition, and the tree may still appear flourishing and healthy.

In the lower counties of the redwood belt—Sonoma and Mendocino—the Douglas spruce is well represented, and its percentage to that of the redwood fairly well maintained at one third of the former, cañon, ridge, and hill slopes all taken into account. Further north the percentage of Douglas spruce diminishes, and in Humboldt County, within the lines clothed with redwood, hardly exceeds five per cent. For the rest, the extent of the resource, as nearly as determinable, may be as shown in Table F. Apart from the redwood, the Douglas spruce may be said to be the only extensively represented tree whose lumber is generally held in sufficiently high esteem by millmen to make it saved for market—the only tree which is not being destroyed without any return whatever. Even here the cutting of "Oregon pine" is regarded more as the utilization of a "waste product" than as a legitimate object of milling operations, and the profit in shipping it to San Francisco is said to be very small. Under these circumstances one can hardly speak of a regular output of "pine" lumber from our redwood mills, the product being merely incidental, and liable to fluctuation from year to year, more, probably, being cut when the price of Oregon pine is high than when this class of lumber is at a discount. It is from Oregon and Washington Territory that the main supply of "Oregon pine" is shipped to the San Francisco market. Our lumber statistics show

that for the year from October 10, 1884, to October 10, 1885, there were shipped by the mills on this coast:*

Shipped to San Francisco	175,858,011
Shipped coastwise	30,562,578
Shipped foreign	90,855,598
Total feet	297,276,187

although these figures do not apply exclusively to Douglas spruce, the so called "spruce" lumber (Menzies' spruce) being included in the above. The consumption of San Francisco and points directly drawing their supplies from this market may, therefore, be approximately stated at 175,000,000 feet, and as most of the lumber shipped coastwise probably was landed in California, the total present consumption of the State (especially taking that of localities supplied from local mills into consideration) can hardly be much short of 200,000,000 feet.

Of this amount—save as a general indication of what the total absorbtive capacity of our lumber markets is—there interests us more especially that portion cut by the mills in California.

The cut by local mills, operating simply to satisfy home demand, is small and fluctuating and the figures for any one year would hardly gauge this source of consumption. From the redwood mills there were shipped to San Francisco of pine lumber during the year 1885, 17,000,000 feet. This is the main item in the cut of "Oregon pine," although probably this figure might be reasonably increased to 25,000,000 feet, provided it were to cover all the wood of this kind produced annually in the district under consideration. A by no means insignificant item is that of split rails made from Douglas spruce, used in building fences. These being manufactured on the ground no count can be kept of them.

Unlike the redwood, the Douglas spruce is a tree rapidly on the increase. Young saplings may be counted by the thousand, and wherever fires do not prevail new growths make their appearance. Being a hardy tree, and, when growing in sheltered localities, a producer of good building timber—under all conditions of growth valuable as fuel—no tree in our forests promises to be of more permanent interest to our people. Needing little care, growing almost everywhere, being of fairly rapid growth, and always, among the coniferous trees, a good producer of shade, any work in the province of practical forestry can hardly dispense with the Douglas spruce.

As to the rapidity with which the tree grows, this probably greatly depends upon soil and other local conditions, as upon these elements the whole habitus of the tree depends. Being at times almost columnar, tapering but little when a sheltered growth and produced on good soil, and again, when much exposed, being strictly pyramidal, measurements made only upon sections of the tree can hardly correctly gauge its growth. We regret not being able to furnish fuller figures than the following, but append them as being records of fair average rates of growth, the trees upon which the measurements were made having been of regular proportions and generally well developed:

*As published by Mr. Thayer, Secretary of the Pine Lumberman's Association.

RECORD OF RING GROWTH.

Measurements on Douglas Spruce.

Diameter of Log.	Number of Rings.	Variety.	Remarks.
36 inches	93	Yellow fir	Locality: Headwaters of Burr Creek, on Overland Road between Blocksburg and Eureka, Humboldt County. The innermost 12 rings measured $3\frac{1}{2}$ inches. Average width of innermost 12 rings, $\frac{7}{24}$ inches.
$33\frac{1}{2}$ inches	98	Yellow fir	On Norman's Ranch, on same road: the innermost 4 rings measured $1\frac{1}{2}$ inches, or an average of $\frac{3}{8}$ inches per ring. The outermost 16 rings measured $1\frac{2}{10}$ inches, or an average of $\frac{3}{40}$ inch per ring.

THE YELLOW PINE.

(*Pinus Ponderosa.*)

[*Locally known as "yellow pine," "pitch pine," and "bull pine," in the coast counties; one dark barked variety often termed "black pine," in Trinity County.*]

The yellow pine in the southern counties of the Coast Range is a purely inland growth, but constantly approaches nearer to the coast as one nears the dividing line between California and Oregon, until finally, about Smith's River, it joins immediately on the redwood belt. From the lines upon which it makes its appearance eastward, it continually gains in percentage of representation and soon becomes the preponderating species.

It loves warm, sunny exposures and grows freely on dry, red volcanic soils.

Its range of altitudes is less prescribed in the Coast Range than appears to be the case in the Sierra Nevadas, and to fix a lower limit of elevation would hardly be possible, as it may be found at Calpella, in the Russian River Valley, at an elevation of less than six hundred feet, and has been seen growing on the Smith River and its forks at altitudes but little above the sea level. Wherever the necessary warmth and proper degree of dryness of soil are found, it makes its appearance; on the other hand, the writer has seen it growing at its best development at an elevation of three thousand two hundred feet, and knows that it is to be found at higher altitudes, so that, though the yellow pine is not a tree which seeks high altitudes, he at least is unable to state the upper limit of its growth.

Throughout the range, fine specimens of the tree may be found, say from 3 feet in diameter up to 6 feet and more, and many specimens are from 150 to considerably over 200 feet in height, their clean cylindrical shafts free of limbs for from 40 to 70 feet above the ground. Yet the lords of creation are always rare, and the average yellow pine is hardly a lordly tree.

The great majority of the trees do not exceed 2 feet in diameter nor 100 feet in height, and these are the finer specimens of the younger growth, trees of even half the size being more common by far. With these the limbs grow low down, and the trunk has not as yet clothed itself with the smooth, regular external covering so attractive in the larger trees. The

bark adheres in felt-like matted streaks of uncertain shades, varying from reddish brown to black.

The yellow pine, characteristically an open growth tree, loves not dense shade, nor does its open and somewhat thin foliage cast heavy shadows. Usually studding the ground in open groves, it is seen at its best growing among other trees, which it usually outnumbers. Sunny mountain sides, of not too steep slope, it much frequents, and often taking almost complete possession of these, leaves the ridge summits to the sugar pine and cedar, the ravines to the Douglas spruce and firs.

While the above disposition is characteristic in the better timbered forests, though not rigidly maintained, the yellow pine often seeks a southern exposure, and whole districts will be found in which it replaces the other conifers almost completely. When this is the case, its own growth is apt to be but an indifferent one.

The yellow pine is in the interior by far the best represented conifer, and it promises to increase in mere numerical representation rapidly. In fact, what development the young saplings now growing by the million in closest proximity, since the cessation of systematic firing of the woods, will attain to is difficult to foresee.

Yellow pine has been always more or less extensively used in the interior for lumber, yet the product can hardly rank high in the scale of our woods. When trees are obtainable with straight grain the lumber may be less open to the objections urged against it than is generally the case. Yet under the best conditions little wood can be obtained which is free from knots, and the yellow pine will probably always be a rough lumber.

At least in the Coast Range, it shows a marked tendency towards twistiness of grain, and but little of it (the pin-knots also prevent it being such) is free splitting. It is a heavy and highly resinous wood, and generally the lumber, when exposed to the sun, warps badly; large timbers often twisting into inconceivable shapes, and boards are given to wrenching themselves loose from their fastenings, causing much trouble to keep them in place.

As with so many other trees, the lumberman seeks here also to draw lines of classification unrecognized by the botanist, and claims to distinguish by the outer appearance of the tree the legitimate from the bastard species. These, in Mendocino County at least, are respectively known as "pitch pine" and "bull pine,"* the term yellow pine being little used. The woodsman, basing his classification purely upon the wood yielded, and little hampered by botanical distinctions, regards these varieties as two distinct trees, and always speaks of them as such.

The yellow pine, on account of its immense representation, is surely destined in time—as other woods become more scarce—to furnish a large percentage of California's supply of lumber. Yet there are woods to-day in every way more suitable for furnishing fine lumber, which are being systematically exterminated without being put to any use whatever.

Of all the qualities of the yellow pine, the special facility with which it grows upon exposures little suited for other trees promises to recommend it to use in the future forestry of the State; yet, as a tree it neither presents a large amount of leaf surface nor does is produce the dense shade which many of our other trees so readily furnish.

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*This term the yellow pine shares with many of the other pines, it being generally resorted to to characterize any pine not of recognized value. Thus in various points of the belt we have *muricata*, *contorta*, *tuberculata*, *ponderosa*, *sabiniana*, and *monticola* (?), all locally known as "*bull pine*."

THE SUGAR PINE.

(*Pinus Lambertiana.*)

In the Coast Range the sugar pine probably never attains quite the development which the finest specimens of the Sierras show, yet here, as in other parts, it stands acknowledgedly the sovereign among pines. Whatever the mammoth tree may be to the pleasure-seeking tourist, the sugar pine is the tree which, in the woodman's estimation, entitles it to first consideration;—a recognition the tree has attained at its cost. Wherever civilization has advanced the sugar pine has suffered, the finest trees having been cut to yield shakes for the settler's cabin, or to be put to any of the multifarious uses which farm improvement suggests.

Never a heavily represented tree, never forming forests by itself, it will be found—often only as isolated specimens—pretty generally scattered over the Coast Range. Even Sonoma County is said to exhibit specimens of sugar pine near the headwaters of Galloway Creek, while in Mendocino County the tree may be found in many localities. On Mt. Sanhedrim, and along the watershed between the Sacramento River and the waters which drain into Eel River, sugar pine is said to be common on the high ridges; and, if descriptions of the tree are to be relied on, the sugar pine here is often of good quality and fair size.*

The sugar pine, although a tree favoring rather higher altitudes, appears always more or less closely associated with the yellow pine, and is seldom found far separated from the latter. Thus, as the yellow pine approaches the coast the sugar pine follows it, and is found side by side with it, coming down to the flats of Smith River—therefore, near the northern limits of the State, growing at elevations but little higher than sea level.

It seems more choice in the selection of soil than the yellow pine, and seldom, if ever, grows save where snow falls. Flat ridge summits it much affects when the soil is good, and if not directly crowning the crest, steals just far enough under its lee to escape the full sweep of the wind, possibly also seeking the snows, which always accumulate more heavily just over the brow of the hill.

Sunlight it certainly seeks—the morning sun and the cross lights of sunset—but it seldom grows on parched lands, and frequents northern exposures rather than southern ones. The ravines it generally leaves to the Douglas spruce or the firs.

Only once does it cross the redwood belt; appearing (here unaccompanied by yellow pine) on the headwaters of one of the tributaries of the Matole River, almost within sound of the breakers.

Del Norte County presents one of the most interesting fields for the study of the sugar pine, the tree possibly showing peculiarities of growth not elsewhere to be seen.†

Some of the peculiarities here shown by the sugar pine are referred to in Appendix B. For the rest, the wood of the sugar pine is too universally known to need special notice here, and, of course, the wood in the Coast Range preserves all the general characteristics of that produced in the Sierra Nevadas. It may be said, however, that generally speaking much less clear length will be observed here than there, and that a more than usual

* The few sugar pines seen by me in Mendocino County were but dwarfed representatives of the noble tree.

† Laurels may be in store for the botanist who first makes systematic study of these rugged hills.

percentage of sugar pines show a tendency to a spirally twisted grain, and that free splitting trees are rather the exception than the rule.

The sugar pine is a comparatively poorly represented tree, and its representation will certainly not exceed five per cent of that of the yellow pines. Among the young saplings the percentage of sugar pines is much less, even, and we may easily count one hundred young Ponderosa to one juvenile Lambertiana. Moreover, being a tree of comparatively slow growth, a couple of centuries must elapse before trees of any size can be produced.

We have here only another instance of the fact that our noblest trees and most valuable woods are not increasing, while our forests are becoming stocked with inferior growths.

THE CEDARS.

1. The Port Orford Cedar.

(*Chamæcyparis Lawsoniana.*)

This choicest of our cedars appears in the extreme northern portion of the State, just where the redwood-cedar shows the last signs of extensive development. It belongs, more strictly speaking, to the trees of Oregon than to those of California, and was at least once extensively represented along the coast in Curry and Coos Counties, Oregon, but it has suffered greatly, it is said, from forest fires.*

There are evidences of this cedar having been formerly more widely distributed on our coast than at present, and it would appear that its place has been taken by redwood and probably more especially by spruce *(Abies Sitchensis).* On the flats immediateiy north of Crescent City and in the vicinity of Lake Earl, burnt cedar stumps are found among standing spruce, and are so common as to suggest the cedar having once been the predominant tree. However, as this *chamæcyparis* is a lover of low, rich, moist soils, and probably never climbs to any considerable altitudes, its development must always have been a restricted one.

Although still pretty generally scattered over the low bottom lands back of Crescent City, in isolated specimens and at times in groups of a dozen trees where the ground is swampy, it is only once in our State found collected as a forest. Along the north bank of Smith River, for a distance of about three miles above the town of Smith River Corners a considerable body may be found, extending back from the banks of the river about one half mile. The cedar on this tract has been estimated as capable of yielding about 2,000,000 feet of lumber.

The wood of the Port Orford, or Oregon cedar, is probably choicer than that of any other coniferous tree of California, not excepting the softest and best sugar pine. As the tree hardly develops branches at all, in the ordinary sense of the word, long drooping sprays of flat delicate foliage depending gracefully from the straight shaft—knots it has none, and the grain of the wood being straight and fine, almost to uniformity, a more beautiful working wood can hardly be conceived of. It is light creamy in tint, highly satiny in finish, takes a beautiful polish, and is wonderfully

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*A fire which occurred about the year 1843, and which ran from Siyou Slough to Coos Bay is said to have frightfully ravaged this belt (of but limited area, at best).

fragrant. It is one of our few highly prized woods, and is especially valued for boat-building, and besides its other admirable qualities, shows powers of resisting rot, which only the redwood can rival.*

2. The Yellow Cedar.

(*Chamæcyparis Nutkaensis? or, Cupressus fragrans* (*Kelloggii*)?

The yellow cedar, or bastard cedar (as it is locally termed), differs but slightly from the white Port Orford cedar in external appearance, save that the foliage shows coarser leaves and a yellowish cast not common to the other, which is purely green—emerald green. Standing immediately with the Port Orford cedar, and closely allied to it, it has a wider range, and while the Lawson cedar is a purely local development, and, probably, does not appear back of the redwood belt at all (or very rarely), the yellow cedar may be found far inland, on flat moist ground on the banks of streams, and often appearing at not inconsiderable elevations where the slopes are level and the ground not too dry. Isolated specimens will be found all the way down the coast as far as Mad River, on some of the tributaries of which it is pretty well represented.

Its wood does not compare with that of the white cedar, and is characteristically rotten hearted. The common run of trees, seventy-five to eighty feet high, by two feet (sometimes three feet) in diameter, does not differ in size from the white; its bark is similar (much resembling that of the smoothest brightest barked redwoods, although often having a silvery tinge), though the yellow cedar often shows a channeled, even strongly fluted, trunk, which I have not observed in the white cedar.

The wood of this cedar, varying in color from faint boxwood yellow to dull cinnamon, splits freely, and it furnishes posts and shingles, but is held in small esteem among lumbermen, probably on account of the rareness of logs which are not pretty well eaten out at the heart. In fact, not unfrequently a few inches of sound wood is all that remains, the heart being completely gone.

3. The Incense Cedar.

Librocedrus decurrens.

This cedar is so generally well known that passing mention will here suffice.

The incense cedar makes its appearance with the yellow pine and sugar pine just back of the redwood belt in Del Norte County, and follows the general lines of the sugar pine south, through eastern Humboldt and Mendocino Counties, though like the sugar pine, it becomes less frequent and

* Of its peculiar durability under exposure, Mr. Henry Harvey, County Surveyor of Del Norte County, notes a curious case. A cedar log stood some years ago near Crescent City which measured eight feet four inches through. Over this a redwood had grown seven feet three inches thick, so that the cedar lay wedged in its trunk. The cedar, standing on a slightly elevated knoll, although on low ground, was still sound, save the sapwood, and furnished eight logs, which were split into shakes, and the redwood, according to Mr. Harvey's recollection, showed upwards of eleven hundred rings. (This indicates the fact that redwoods of slow growth may be found on low ground near the coast of Del Norte County as well as those of phenomenally rapid growth, as the one cited in Table E.)

The only opportunity for making measurements upon a white cedar was upon a stump, the core of which had been burnt out for a distance of 7¼ inches from the core; following this the next fifty years growth was recognizable, and measured just three inches, or for this period of the tree's growth $\frac{1}{17}$ inch per year. After that it was impossible to trace the grain, which, besides being very close, was badly charred. Even this imperfect measurement proves the tree to be of slow growth, as the log, which was three feet in diameter, could not have been less than three hundred years old.

less heavily developed the further south one goes, and increases in representation as one proceeds eastward into the heart of the range.* It is found especially well represented on the high ranges between the Eel and Mad and Trinity Rivers, but seldom grows to more than one hundred feet in height nor is heavier bodied than three (or rarely four) feet. All through Trinity County it is a common tree and, after the yellow pine, has developed more young saplings than any other tree.

Excellent as the wood is when sound, the tree is much subject to disease, being generally riddled by a fungus growth (a *dædalus).*† While this does not necessarily render the wood unfit for many purposes, it renders it valueless for lumber of the finer kinds. When sound it is as fine a wood in every particular as the redwood, the place of which it fills in the interior counties. It is a free splitting wood, and stands exposure to alternate dry and moist influence admirably, and is locally much used for making fence posts.

While generally a lover of high altitudes, associating freely with the sugar pine, it will at times descend on sunny exposures with the yellow pine, and seems capable of growing wherever the yellow pine grows. On the flats of Smith River it grows but slightly above the sea level, while on the other hand it seems to thrive up to the highest altitudes.

It is a cheery tree, and yields better wood and produces more shade than does the yellow pine, besides possessing much of the adaptability to varied exposure which that tree shows; for which reasons it will be found worthy of consideration in many places where it is desired to increase the growths of trees.

THE MENZIES SPRUCE.

(*Abies Sitchensis.*)

[*Locally known all along the coast of Humboldt and Del Norte Counties as "spruce."*]

This spruce is essentially a coast tree and a frequenter of bottom lands, although it is occasionally seen at considerable heights above the sea-level. When this is the case, the development is contrary to the general rule of trees that are about to give out, often an exceptionally fine one.

A dozen specimens of this spruce may be found at the mouth of Hare Creek in northern Mendocino County, after which sporadic appearance the tree is not found until it again appears above Cape Mendocino, at the mouth of Oil Creek, and then in all the gulches which open directly to the sea. The bottom lands at the mouth of Eel River are well clothed with it—or rather, were so—and from this point north, up to the State line, it fringes the redwood belt on its western skirt, an almost uninterrupted development, disappearing only where the soil is too poor to maintain it.

The tree, with its wide base and tapering (pyramidal) shaft, is well adapted to face the wind, and its growth is usually so dense as to successfully turn the storm. It is a handsome tree, with its clear, smooth-barked trunk, its dark, somber foliage, its numerous limbs, which fall in regular,

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* Exceptionally the incense cedar invades the lines of the redwood belt, and is found, for instance, on the Boynton Prairie ridge back of Arcata.

† See Kellogg's Forest Trees of California, page 18.

parabolic curves on all sides of the shaft. This is often six feet through at the base, and the height, not seldom, is close upon one hundred and fifty feet.

Where sheltered from the winds, the limbs do not come down closer than to within thirty or forty feet of the ground. Yet, smooth as the trunk may appear, the branches formed in early youth remain as pin knots under the bark and sapwood, and the wood of the spruce, although soft and mellow, satiny in texture, and fine in grain, makes but knotty lumber; hence, its low estimation among lumbermen generally. For outside use it is not fitted on account of its proneness to rot, for it decays in a few years, when exposed to moisture. So the wood finds but limited application, and is relegated to the manufacture of boxes and similar small stuff—butter firkins and the like—or is made into "dunnage boards" for vessels, or put to other inferior uses, though in any but our glutted market it would command esteem.

Of all our trees, probably none shows less power to resist fire, and smoldering fires, even, are sufficient to scorch its thin bark and but poorly covered roots and kill the tree.

Wherever it appears with the redwood, it is of course radically exterminated when the land is logged, and unfortunately none of the mills, save only those at Crescent City, now make any attempt to utilize the wood. The attention of mill men is forced into other channels.

The Menzies spruce has an established reputation for seeking good soil and only growing upon such. Besides this, of all large trees, none can be cleared away with as little difficulty nor at as small cost.

A few brisk strokes of an axe girdles the tree; a small fire kindled around its trunk—a few minutes work in either case—kills it. A year later only a dismantled shaft remains, and this rots and blows over a year or two later. Finally nothing but the stump is left, and this is easily removed. The tree makes no effort in the meanwhile to reproduce itself. Once killed, nature may be left to complete the work; any subsequent labor expended is simply to accelerate destruction.

The Menzies spruce has yet a few years allotted to it, and then it will, in this State, belong to the things of the past.

The tree is a rapid grower, and when the conditions are favorable to its growth spreads rapidly. Of this we have proof in the so called "Deadenings" near Crescent City. They were bald as the palm of one's hand when the town was first built, but they are now forests of young spruce.

The Sitka spruce yields dense shade, and does not suffer by being thickly clustered. For this reason it might be a tree suitable for the forester's use; yet its adaptation to none but rich soils, and its probable restriction to low altitudes, would necessarily much limit its application.

As a wind-break it might do better service, and being a tree of striking appearance, and, though somber, of regular port and graceful habit, it may serve to good purpose in park gardening.

THE FIRS.

1. The Grand Silver Fir.
2. The Great White Silver Fir.
3. { *a*; The Magnificent Red Silver Fir.
   { *b*; The Noble Silver Fir.

1. THE GRAND SILVER FIR.

(*Abies* [*Picea*] *Grandis.*)

[*Locally known as white fir*, *or balsam fir.*]

This fir makes its first appearance on the coast a few miles below the Gualala River, and from here north, as far as the Eel River Valley, is a common tree, which often attains considerable size. It skirts the redwood on its westerly line, but is mainly found in the short gulches which open directly to the sea. After passing into the Humboldt redwoods, it becomes a well represented accessory tree, and remains such until the State line is reached. On the Eel and Van Dusen Rivers it skirts the redwood, and is common on the Mad River, where it forms bodies by itself at times, and, displacing the redwood, takes complete possession of many of the ridges. The most easterly point of its development was observed on Larabee Creek, not far from Blocksburg, where a few trees are found.

Of all the woods which are undervalued, and which are systematically allowed to go to waste, this is intrinsically one of the most valuable. Barring its proneness to rot away entirely in a year or two, when placed in contact with the ground, it is an excellent timber. For inside use, few woods surpass it. It is soft and white, works well, and holds a nail remarkably well—as is observed by Dr. Kellogg—who also notes in his "forest trees" (page 25), the peculiar variation shown in the rate of growth of this fir. It is believed that this difference in the rate of growth may explain the varied deportment of boards, made of this wood, under the action of wind and weather.

Near Eureka there stands a house which is covered with white fir boarding, and which, after twenty-eight years of exposure, is still sound, while I have also seen boards of rapid growth—nearly three eighths of an inch per year—which, after a few years' exposure, were worthless. The wide bands of summer fiber had been literally worn away under the action of the rain, leaving the narrow walls of winter growth projecting in unsightly ridges. Yet this refers to its use for outside purposes, for which it is not fitted. I have seen one sitting-room ceiled and wainscoted with white fir, and which had been oiled and lightly varnished, which produced as cheery an effect as could be desired. Used under water entirely, the white fir is said to last well, and Mr. Alexander Connick, of the Occidental Mill, at Eureka, informs me that he has seen white fir logs in dams sound and serviceable after redwood saplings had rotted out.

At present the white fir may be said to find no use whatever. It finds a limited application for "dunnage" boards for vessels, and Messrs. Hobbs, Wall & Co., of Crescent City, utilize the wood to some measure in making boxes, but even for this purpose a prejudice prevails against the wood, on

account of its pronounced odor. If I am right, however, this fir is utilized to make butter firkins of in the Eastern States, the wood probably being water-soaked before being used. At one time quite a trade existed in white fir barrels sent to the Sandwich Islands for packing sugar, but of late years the demand is supplied from the East. It is sufficient evidence of the good qualities of the fir, that so soon as one passes out of the districts where redwood is in use, the white fir becomes a highly esteemed wood.

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2. THE GREAT WHITE SILVER FIR.

(*Abies* [*Picea*] *Concolor.*)

This is the fir of Trinity County, and is found tolerably well distributed in all the better wooded portions of the county. For the finest specimens of the tree, one must look on the higher ridges only, where (as on the South Fork Mountain) it crowns the summit, coming in above the other growths. Here, fine trees, from one hundred and eighty to two hundred feet in height, with trunks four and five feet in diameter, are found. The bark of these trees, which is peculiarly heavy at the base of the trunk, is, save for its woody texture and lack of elasticity, quite similar in color and general appearance to cork. Almost equally fine growths extend in the cañon heads for some distance down the sheltered slopes. Along with the finer specimens, however, the tree is found in more stunted growth, as trees which do not exceed one hundred feet in height nor two feet in diameter, these trees showing a rough scaly, almost black bark, the color of which does not vary from that of the larger specimens. These smaller trees becoming ever more reduced in size as they descend to lower altitudes or are more exposed to heat, show themselves more or less all over Trinity. While, therefore, not strictly confined to ridge summits nor to cañon bottoms, these are the natural abodes of the fir.

The western slope of the shed between the Eel River and the headwaters of the Van Dusen is the most westerly observed limit of this fir, which first makes its appearance at an altitude of thirty-six hundred feet.

It extends east to the summit of the Trinity Mountains, and follows the range south into eastern Mendocino, while to the north it extends to the high divide which sends its waters northward to the Salmon River.

The wood of the fir is classed with the sugar pine as the best material in the county, and the *concolor* fir, among all its kindred, enjoys the distinction of not only furnishing good lumber for use under cover, but timber also which will endure for years the critical test of being used for sleepers, and which does not rot when half-bedded in soil.

3. *(a.)* THE MAGNIFICENT RED SILVER FIR.

(*Abies* [*Picea*] *Nobilis, variety Magnifica.*)

(b.) THE NOBLE SILVER FIR.

(*Abies* [*Picea*] *Nobilis.*)

[Often locally known as "Spruce," although by some properly termed "Silver Fir."]

These two firs, probably always growing together, belong to the trees of the high Siskiyou Range, and have not been observed at altitudes less than three thousand three hundred feet. They are also found east of the Klamath on the Salmon River Range. These firs come in above the sugar pine, and even the Douglas spruce, which here attains its most magnificent development, and rivals these noble trees in grandeur, cedes to them the loftiest sites. As far as my observation goes, the red silver fir is rather the larger tree of the two, and is the grandest tree in the Coast Range. Its straight, columnar shaft, often eight feet in diameter, rising over two hundred feet in height, is enveloped in uniform whorls of magnificent foliage, the tint of which, while distinctly silvery, is pronouncedly a smoke-blue, rather than a green. The massive trunks are of a rich cinnamon, almost Indian-red color; and the beauty of the tree is enhanced by the thousands of thickly-fuzzed silvery cones which crown the upper limbs. The nobilis rivals the red fir in size, but has a finer foliage, and the cast is silvery green, not silvery blue.

As to the value of these firs as wood producers, no reliable information was obtainable, save that they are not esteemed, on account of their alleged inclination to rot speedily when cut and left on the ground. Yet this objection is urged against so many of our woods which are known to be excellent when treated with care, that until tested and their deficiencies are proved, no case can be considered as made out against them.

Apart from any value which the firs may have on account of the woods they yield, they are trees of primary importance, both on account of their rapid growth, their range of distribution, and their predilection for ground upon which the snows lie deep in winter. The importance of trees of dense foliage growing high up among the heavy snows, cannot be overstated. They, and the Douglas spruce, are our greatest benefactors, and in this connection are to be valued far in advance of our more open foliaged pines. Just where our Spring sources need protection most, these trees make their abode, and close aggregation and dense shade are no deterring influences to their growth.

THE OAKS.

The oaks of the Upper Coast Range are:

1. The Tanbark Oak, or Evergreen Chestnut Oak.
2. The Golden Leaf Cañon Live Oak.
3. The Pacific Post Oak.
4. The California Black Oak.
5. The California White Oak.
6. The Highland Live Oak.

For a description of these oaks, their distinguishing features and much special information applying to their appearance in the Coast Range, attention is called to Dr. A. Kellogg's "Forest Trees of California" (see appendix to the second biennial report of the State Mineralogist). Time and space will only permit here of brief mention of the parts of the range where they are common, with a few notes on their economic value, and the uses to which they are at present devoted—when utilized at all.

1. THE TANBARK OAK.

(*Quercus densiflora.*)

[Often locally known as Spanish Oak.]

This oak is found well represented all through the redwood belt, at points where the redwood thins out and becomes scanty, consequently, in the lower redwood belt, it characterizes the summits and upper slopes of ridges, whereas, further north it forms a more or less continuous fringe, which skirts the belt all along its inner borders. The district around Shelter Cove from the Usal Creek to the Matole River shows an exceptional development of this oak. It may be found still moderately well represented for a considerable distance inside the redwood, appearing in patches a few acres in extent, for about fifty miles back of the coast. Even here it does not become entirely extinct, but becomes choicer in the selection of its sites, generally confining itself to more sheltered and shady localities, and, instead of seeking the warmer exposures, as it often does on the immediate coast, it skirts the streams and nestles in the gullies at the heads of watercourses, in the warm interior districts.

On the slopes of the Klamath, it is not uncommon, but becomes scarce upon the western flank of the interior backbone of the Coast Range, appearing again, however, after the divide is passed, but only as a scarce tree on the slope which drains into the Sacramento Valley.

It will be often found extending for miles, a tree or two here, a tree or two there, say one tree of fair size to the acre, but the heavier developments are generally confined to thickets of a few acres in extent. Again, the growth will become the predominating one, and the trees are then apt to be so thickly aggregated as to form a dense shade; but in this case the tree shoots up with slender, stalk-like trunks of but a few inches in size, and the foliage forms a dense mat overhead. Otherwise, where protected, but favored with sufficient warmth and sunlight, the tree assumes a strictly

arboreal habit, and is a very handsome, regularly shaped tree, much more symmetrical than any of the other oaks. On parched lands it often becomes a shrub, and covers the ground as dense brush, forming a covering at times not over a foot or so in height, or forming bushes breast high. On the whole, save the old and regular trees, which are rather exceptional, this oak shows greater inclination to degenerate into a bush than any of its cousins.

The chestnut oak is of great economic importance, and a well sustained demand for its bark exists. The wood furnishes one of the finest stove woods on the coast, and always fetches the highest price. It is a wood which splits freely, and shows a straight, somewhat coarse grain, the cell-ducts being clearly discernable. For an oak it is a soft wood, and, though saplings are tough, it is rather brittle than otherwise when matured, and is then prone to check. Left exposed to sun and rain, it rapidly falls to pieces from dry rot. It is not known what valuable qualities special treatment might develop, but it is probable that it would repay the labor of investigation.

Heavy bodied trees often show a bark-covering of almost two inches in thickness, and it is these old trees which furnish the best yields of bark. The slender bodied trees have but a thin covering, and are less profitable to the bark gatherer. The chestnut oak is a resource of considerable importance, and one which is being rapidly exhausted. There is always a market for the bark, and as rapidly as new roads develop a new section of the coast, the available bark is soon cut out.

There is probably no tree which has been so systematically wasted as this oak. As the bark is the portion of the tree for which the highest price is paid, this becomes available for market in advance of the wood. The common practice is therefore to cut down the trees and strip them, leaving the valuable wood to perish on the ground—this then becoming a serious source of danger from forest fires. As facilities for transportation extend, the shipping of bark extends also. Just so soon as living wages can be made at the business, the attack upon this tree commences. It is a poor man's resource, and like all property of the needy, is given freely for small immediate gain. An approximate estimate of the present resource, necessarily but a very rough one, will be found in Table F. The annual consumption appears to be about sixteen to twenty thousand cords of bark.*

As regards the yield of bark per acre, this of course varies immensely with the development, as also somewhat with the degree of care exercised in stripping the trees. Isolated acres are said to have produced as high as twenty-five cords. It is pretty good bark land, however, which will produce five cords per acre for a forty-acre tract located according to legal subdivisions. Mr. F. Helmke, at present of Blocksburg, has cleared a tract of two thousand acres, a third of which he considers to have been bark land, and which yielded fully six cords to the acre—four thousand cords for the whole tract.†

* Two of the best informed firms in San Francisco were applied to, to give an estimate of the consumption of bark. Messrs. Higgins & Collins believed that San Francisco consumed about twelve thousand and the Santa Cruz tanneries about four thousand cords of bark annually. Mr. Kullman, of the firm of Kullman & Salz, said the figures would not run below sixteen thousand cords for San Francisco, and about four thousand cords for Santa Cruz; say twenty thousand cords all told. No systematic record of consumption is kept. Thanks is expressed to both firms for their information.

† This is one of the best authenticated yields on record, both the acreage and the yield being accurately known. The figures apply to a part of the German Rancho in Sonoma County. The ranch was good bark land, and Mr. Helmke says it compared favorably with the tanbark country on the Usal, which is of the best.

The tanbark oak is a tree which probably might be successfully cultivated. I am informed that in Mendocino County sprouts from stumps, when kept properly trimmed, will in five or six years develop to trees twelve to eighteen feet in height and four to five inches thick. This is the experience of Mr. William Steven, of Low Gap. When trees are cut a wreath of sprouts usually springs from the stump. These remain stunted growths, if left uncared for, but when properly trimmed develop into trees. For artificially propagating this valuable tree the acorns would of course be available.

An apparent anomaly exists in the fact that quotations for tanbark cord wood always range higher for wood which is stripped of bark than cord wood with the bark adhering to it. The wood without bark is summer cut, while that with persisting bark is cut in winter. Why, in this case, the summer-cut wood should be prized above that cut when the sap is down is not clearly seen.

In reference to the stripping of tanbark, it may be observed that trees which have been scorched by fire do not strip readily.

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2. THE GOLDEN-LEAF CAÑON LIVE OAK.

(*Quercus Chrysolepis.*)

[Locally known as "Mall Oak," "Iron Oak," or also as "Florida Oak.]

This fine oak, in several sub-varieties, is found pretty generally scattered over the range, and is an oak which generally seeks warm, dry, sunny exposures. To attempt to define its habitat would be useless. It is more or less common everywhere, and the only place where it can be said not to grow is *among* the redwoods. Colossal oaks of this species are found, while again, like the tanbark oak, it covers whole acres as a dense brush-covering only a few inches high.

This is the only one of our trees which possesses immunity from wanton attack. Save for a definite purpose no one meddles with it, its local name, *iron oak*, being well merited. This is one of the best oaks we have, and saw logs may be easily obtained four, five, and even six feet in diameter. The wood is fine-grained and close knit, but it is not knarly, generally speaking. With the aid of wedges it can be split out into shapely pieces, and when not too old is springy enough to be used for axe handles. Its local use is especially for making malls, but its applicability to any purpose where hard wood is required is generally recognized, and it is used successfully for felloes and hubs of wheels and many other purposes, always sparingly, however, for its wood shapes itself to the wants of man only at the cost of labor and the sweat of his brow. The wood dresses well, and, save for its hardness, is free-working. For ship-knees it probably would be exceptionally serviceable, as Dr. Kellogg remarks. The "Forest Trees" refers to this tree as a close kinsman to the *quercus virens* of the Atlantic seaboard States, and rates it as an equally valuable wood; valuable enough therefore to be the object of especial governmental solicitude and protection.

3. THE PACIFIC POST OAK.

(*Quercus Garryana.*)

4. THE CALIFORNIA BLACK OAK.

(*Quercus Kelloggii or Quercus Sonomensis.*)

These two oaks—the one known everywhere as "black oak," the other as "white oak," and not generally distinguished from the California white oak proper (*i. e.*, *Q. lobata*)—are always so closely associated that the one seldom appears without the other. These may be called the typical oaks of the Coast Range.

Both appear as large and handsome trees, and both appear as dwarfed specimens, aggregated together by thousands; and growths of this kind, mixed with other shrubbery, often forms what is designated on the filed plats of surveys as *chemise* or *chaparral*. These are the extremes, and between the two, trees of any size and order of development are common.

Both trees furnish good wood. The post oak, as its name implies, is much used for fence building, and is straight grained and free splitting, and when not too old, supplies good and supple wood, which is used for many purposes. It makes good pick handles and wheelbarrow shafts, and will, if properly treated, make good wheel spokes. Both it and the black oak make good fuel, although the latter is rather preferred for this purpose. The black oak, when young, is very supple, and is somewhat used for making bands for barrels. The black oak especially is often a trim and shapely tree, and I especially remember one specimen, which, growing under the lee of a large yellow pine, had grown straight as the pine, which protected it, and had no branches lower than fifty feet from the ground, the diameter of the tree being over four feet at the base.

Both trees, if cut in the right time of year, ought to make excellent railroad ties.

The post oak and the black oak are the predominating oaks all through the zone between the redwood and the summit of the inner Coast Range divide.

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5. THE HIGHLAND LIVE OAK.

(*Quercus Weislizeni.*)

This oak is reputed to furnish good timber (see "Forest Trees of California," page 107.) I have not seen it anywhere, however, save on the slope to the Sacramento Valley, in Shasta County. It is reported to appear throughout the Coast Range, yet neither in Del Norte, Humboldt, nor Mendocino Counties have I observed it, nor in Trinity, save east of Weaverville, and here it is but rare. Even in western Shasta, at least as far east as the Sacramento River, it is a tree of only small size, hardly over thirty-five feet high, and a few inches in diameter.

6. THE CALIFORNIA WHITE OAK.

(*Quercus lobata.*)

[Often distinguished from the Post Oak as Mush Oak.]

This oak is a valley and bottom-land oak, and it is not extensively found, save on the Russian River, in Mendocino County, and north to the Humboldt line, on the valleys and rolling land, as also on the valley lands of Lake County, and predominates in the upper Sacramento Valley. This oak is heavy bodied, and forms large trees, but the wood is *brash*, and although it is used for fuel, the black oak and the post oak are preferred, whenever obtainable. Besides being a brittle wood, it is given to growing in irregular shapes, which, though they form picturesque trees and furnish fine shade, are too irregular and crooked-grained to furnish valuable wood. Of all the oaks named, this is the least valuable, and it is probably one of the oaks which have earned for California the reputation of having no good oak wood.

MISCELLANEOUS WOODS.

1. Pines.
   A. The Bishop Pine.
   B. The Tamarack Pine.
   C. The Knobby-Cone Pine.
   D. The Sabin Pine.
2. The Pacific Hemlock Spruce.
3. The Nutmeg Tree.
4. The Yew.
5. The Madroña.
6. Laurel, Alder, Ash, Maple, Chestnut, and Cottonwood.

1. PINES.

A. Bishop's Pine. (*Pinus muricata.*)

[Locally known as "Bull Pine."]

Found on the coast outside of the redwood and extends north as far as Ten-Mile River, although as one ascends the coast it decreases in frequency and is replaced by tamarack. The Sonoma coast is its point of heaviest development. This tree is entirely unvalued, and wherever cut out to make clearings is burned on the ground. Some shipments of the wood have been made to brickyards in San Francisco, but as a fuel it is said to be of inferior value. Even this wood may be available for certain purposes, however, and Mr. Helmke informs me that while engaged in lumber manufacture at Fisk's Mills, he sawed two hundred thousand feet of bull pine lumber, which was used as plank for bridge covering, and that it stood the wear and tear excellently and was much liked. This is an instance of how, where there is a will to utilize things, a fit application can generally be found.

B. The Tamarack Pine (*Pinus contorta*).

[Locally known as Bull Pine, and not generally distinguished from *Pinus muricata;* if so distinguished, then often—as in the vicinity of Eureka—known as Squaw Pine.]

Appears on the coast near Point Arenas, and extends north, skirting the shore, in patches of a few acres to a few miles in extent, all the way to the Oregon line. Grows on sandy spits and sandy benches or sandy river-bottoms, but is seldom or never found where the bluffs rise abruptly to any height above the sea. The best development of tamarack is in the vicinity of Fort Bragg, where trees seventy-five to eighty feet in height, with straight trunks of small diameter (twelve to eighteen inches), are to be found. Generally, thirty to forty feet is a normal development. Along the coast the tamarack is much mixed with the bishop pine.

Aside from the coast development, tamarack is to be found in small patches (and then generally mixed with *Pinus tuberculata)* on high ridges in the Siskiyou Range and the bald hills north of the Klamath River. Here the tamarack is a very stunted growth, and seldom grows over twenty-five or thirty feet in height.

The tamarack has a poor record as a wood, besides its small size rendering it of little practical value.

Both the tamarack and bishop's pine are mainly valuable on account of their ability to grow on sandy coast lands, and to flourish under exposure to strong wind.

C. *The Knobby-cone Pine* (*Pinus tuberculata*).

[Also locally known as Bull Pine.]

To assign a habitat for this pine would be difficult. All over the upper counties—Humboldt, Del Norte, and Trinity—it will be found in localities, and always upon dry, parched soil and hot exposures.*

The tree is never very extensively developed, and is characteristically a small pine, twenty-five to thirty feet being its ordinary height. Clear Creek, Shasta County, presents a separate and comparatively speaking extensive development of *Pinus tuberculata*. Here the tree presents a somewhat different appearance from what it does on the watersheds which drain into the ocean. The tree here develops heavy branches for its size, and these divide, and the cones, instead of encircling the trunk only, form on the branches also. The cones are thicker and shorter than on the coast, and their color, instead of being straw-tinted, is brownish red.

A peculiar development of this pine will be found in the Siskiyou Range at high altitudes. Here, dark barked trees, from seventy-five to fully one hundred feet high, and as straight as an arrow, though of very small diameters—probably not to exceed a foot—with limbs and foliage developed only near their tops, are found. The trees I saw stood at an altitude of about three thousand six hundred feet. These trees are said to produce remarkable wood, which is of exceedingly fine texture, and the toughness of whalebone, both in the green and seasoned state. One instance was cited to me of a freight wagon having broken its axle, and a small pine having been utilized to replace it as a makeshift; the improvised axle doing such good service, however, that it was never removed. The wood, while fibrous and stringy, is said to work easily with tools, and take a beautiful finish.

D. *The Sabin Pine* (*Pinus sabiniana*).

[Generally termed "Digger Pine," "Nut Pine," or "Bull Pine."]

This pine is found in Mendocino County, near Potter's Valley, and in the vicinity of Cahto, but not heavily represented. All over Trinity County it is found—from the Trinity River and its forks clear through to Shasta and the banks of the Sacramento River. It affects warm sunny slopes, and together with the oaks, madroña, and, occasionally, yellow pine, forms the main tree-covering of parched southern exposures. The wood is considered excellent fuel, and it is reported to be highly serviceable for many purposes. These may be found extensively enumerated in the "Forest Trees of California," page 45.

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*Heat is essential to its propagation, as its cones adhere to the trees for years, and open and shed their seed only in very hot weather, or after periods of drought. When fires run through the woods and the tree is consumed, this pine sheds its seed, and a year or so later young saplings cover the ground.

2. THE PACIFIC HEMLOCK-SPRUCE.

(*Tsuga Mertensiana.*)

The hemlock is found in the Mendocino belt of redwoods, often developed as fine specimens, but on the whole it is here a rare tree. One could probably hardly cross the belt at any point without encountering from twenty to fifty trees in doing so, but it forms no perceptible percentage of the forest.

Among the Humboldt redwoods it becomes more common, and increases in representation as one goes north, until near Crescent City it becomes a well represented tree. The redwood belt may, however, be designated as its abode.

It makes serviceable lumber for inside use, but rots as quickly as white fir when placed in contact with the ground. It is, however, on the whole, a less valuable wood than either the white fir or the Menzies spruce. It is subject to knots, which the first is not, and it lacks the softness and elasticity of the second. Like the two trees mentioned, it is seldom put to any use, but perishes unutilized when the redwood goes. Hobbs, Wall & Co., of Crescent City, use it for box stuff, but apart from this use it is a wood without a market, unless odd lots of the wood find a chance application for dunnage boards of vessels.

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3. THE NUTMEG TREE.

(*Torreya Californica.*)

This handsome tree is in the Coast Range merely an arboreal curiosity, and it is not found at all north of Mendocino County. A hundred or two hundred specimens would probably cover its total development in Mendocino and Sonoma Counties. If there were but more of it, it would be one of our choicest woods, being soft, and, practically speaking, without grain at all. It is so scarce, however, that no economic importance can be attached to it.

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4. THE PACIFIC YEW.

(*Taxus Brevifolia.*)

This tree is found all over the range, nestling away in the cañons, and always confined to the immediate banks of streams. It is never heavily represented, but at times may be found in thickets of twenty to thirty trees; generally speaking, however, it is scattered along the banks in isolated specimens. In the aggregate, the quantity is not insignificant, and like the mountain mahogany every scrap of it should be valuable. It is straight grained, and, while green, is easily worked, but becomes very hard when seasoned. It is valuable for all turning purposes; makes good pulleys, friction-rollers, and excellent journal-boxes, where wooden boxes are applicable; is suited for a hundred different uses, among others making

the toughest of bows for archery purposes. Trees do not generally exceed a foot in thickness, nor grow much over twenty to thirty feet in height, although I have seen specimens over two feet in diameter, but in such cases the trees taper rapidly as they ascend. It is almost a desecration to enumerate among the purposes for which it is fitted that it makes excellent fence-posts; yet there is no doubt but that more of it has been used for this purpose than for any other. A better fence-post, however, could be hardly conceived of, as it never decays.

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5. THE MADROÑA.

(*Arbutus Menziesii.*)

The madroña is one of the most widely distributed trees in the whole Coast Range, and appears to be a tree which is increasing in degree of representation; at least there are districts where the increase in its numbers has been very perceptible. So, for instance, on the Klamath River, near Orleans Bar, where slopes which were formerly bare are now well covered with trees of this species. It associates itself naturally with the oaks, and grows generally where oaks grow, but has a wider range than any one of the oaks. As it is not shy of a hot sun, besides furnishing fine shade itself, it is a tree worthy of consideration wherever it may be desired to clothe slopes which face the south with groves of trees.

The wood of the madroña is generally only used as a fuel. It is, however, worthy of a higher rank among our woods than is at present assigned to it. The wood is of remarkable uniformity of texture, and very warm tinted in shade. It assumes a fine polish, and being of rather more than medium hardness, should find application to many purposes, where neither great elasticity nor great transverse strength is essential. If carelessly seasoned, boards of madroña are apt to crack at their ends, but this defect could be easily overcome. When cut with the sap running and left to lie on the ground, it naturally rots away in a few years, but if handled with care in seasoning, it ought to be a durable wood.

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6. THE LAUREL, ALDER, ASH, MAPLE, CHESTNUT, AND COTTONWOOD.

Of these trees, the first two, the laurel (*umbellularia Californica*) and the alder (*alnus rubra*), are the most extensively developed and the most important. Both furnish good woods, laurel especially; but its excellence depends entirely upon its mode of treatment and the time of the year in which it is cut. Against the laurel, a prejudice has risen up, on account of its supposed proneness to being riddled by worms, and the demand for this wood apparently has fallen off greatly of late years.* The laurel often

*Dr. Kellogg, in his "Forest Trees"—see pages 101 and 112—gives much interesting information on the subject of the woods of laurel and alder, not the least interesting his explanation of the fact that the attack upon the laurel wood by worms, is only a result of cutting the tree when the sap is up.

forms dense woods (as on the Eel River, near Rio Del). As it generally grows on choice land—always, when the development is such a heavy one—much fine laurel timber is going to waste, and its best developments will be cut away in a few years.

The alder, like the laurel, is not restricted to any portion of the range, but may be found all over it, the larger and finer specimens of alder being commoner, however, in the southern than in the northern counties, the largest trees being found in Sonoma and Mendocino Counties. Both trees find their best developments along river banks, but neither the one nor the other is confined to the immediate vicinity of streams.

The ash (*fraxinus Oregana*) is a tree pretty strictly confined to the banks of streams, and is found as two varieties (as distinguished by woodsmen), the "red ash" and the "white ash." Save that, if anything, the so called red ash has perhaps a somewhat smaller and finer leaf and a ruddier bark than the white, there is no external difference, and trees of the one kind grow side by side with those of the other. While the white ash is said to possess a brittle wood, that of the red is admitted to be of excellent quality. Whether these distinctions are warranted by facts or not is a question, as concerning woods to which little value is attached, much care is not taken by woodsmen to establish distinctions which are often arbitrary distinctions, after all.

The maple (*acer negundo*), like the ash, is found all over the Coast Range, and shows a preference for river banks, but often is found well up towards the heads of ravines, the maple showing the more catholic spirit in this respect. The maple often forms trees of large size, but the wood is at least locally not esteemed, and is considered a "brash" and brittle wood. Both the maple and the ash are too frequently met with to be ignored in an enumeration of the characteristic trees of the Coast Range, but are to be classed rather as rare trees than common ones.

Rather better represented than the preceding is the chestnut or chinquapin (*castanopsis chrysophilla*). This tree is found running in streaks, all over the range, at least from Willits in Mendocino County north. It often appears as a tree of very considerable size, heavy trunk and clear shaft, free of limbs forty and fifty feet from the ground; yet, like the tanbark oak, which tree the chinquapin much resembles, it is also found as a dense-growing shrub, not more than a foot high from the ground.

The chestnut is but another instance of woods which, when properly handled, are good and valuable, but which locally have but poor respect shown them.

The last of this group of trees, the cottonwood (*populus Fremontii*), is a very poorly represented tree, as it is pretty strictly confined to alluvial bottom land; therefore, while appearing almost everywhere where bottom land is to be found, it remains, from the nature of its development, but a rare tree. The wood is considered of little value, though Dr. Kellogg gives it a character differing from its popular reputation. Yet almost all of California's trees are rated at less than their deserts, and will remain so until trouble is taken to study their requirements, and care shown to bring out their valuable qualities by suitable methods of treatment, if it be nothing more than paying attention to cutting them when they are in a state rendering them fit for being cut.

IV.

CAUSES AND RESULTS OF FOREST DESTRUCTION.

1. Notes on the Agricultural Capacity of the Lands of the Coast Range; Probable Extent of Clearing of Forests.
2. Forest Fires.
3. Incipient Signs of Climatic Change.
4. The Effect of the Present Laws Upon our Forests.
5. Concluding Remarks and Recommendations.

THE PRODUCTIVE CAPACITY OF THE UNDEVELOPED LANDS OF THE COAST RANGE.

THE PROBABLE EXTENT TO WHICH TIMBER AND BRUSH LANDS WILL BE CLEARED, UNDER THE INFLUENCE OF AGRICULTURAL DEVELOPMENT.

In a country but sparsely settled, and the resources of which are as yet but little developed, the future of its timber lands can only be forecast by reference to the capacity of its soil for sustaining agricultural operations, or furnishing grasses fit for pasture. It may be safely assumed, that wherever the conditions are favorable for agriculture or grazing, or are liable to become such with moderate outlay, and the growing timber is not very dense, that bush and timber lands will be cleared, as soon as the augmenting price of arable land attains a figure which will pay for clearing. Correct conclusions will only be reached, however, when we judge, not by standards of average days-labor wages, but consider the persistent energy which men show in improving land which they intend making their homes upon; how, with this object in view, they will toil for years without weighing the value of the ultimate return, and eking out a bare subsistence, often hold on in spite of fate to homes which are untenable.

Had days' wages been the criterion by which improvements were deemed suitable or not, America would to-day be a wilderness.*

To go into the examination thoroughly, would lead into a subject as extensive as that which forms the basis of this report. What it is here proposed to do is to furnish a few notes upon the general capacity of some of the lands for supporting stock or for farming; to notice in the briefest manner some of the influences which are at work, tending toward improvement or deterioration. Upon these some other questions hinge, which are more or less directly connected with the subject of Forestry.

1. THE REDWOOD LANDS.

It has been stated under the heading "Reproductive Capacity of Redwood," that the redwood grew upon every formation in the Coast Range. To speak, therefore, of "redwood soil," is an incongruity; however, it is

*I was specially struck by one case which I saw in Shasta County, where, to create a garden patch in land which was phenomenally arid, a small, dry watercourse had been called into requisition. Here a patch of a quarter of an acre or more had been made to furnish good garden stuff, through continued building up of terraces of cobble-stones in the channel of the watercourse, thus forming a series of flat benches, upon which had been wheeled in barrows all the procurable soil for quite a distance round the channel. A side ditch was provided to lead the storm-waters around the garden, and a spring had been developed and lead upon the land. The industrious individual who had gone to all this labor to accomplish so small an end belonged neither to the Mongolian, or any of the almost equally frugal Latin races, but was pure Anglo-Saxon. At days' wages that garden must have represented a small fortune. Even in the redwoods, now and again, instances of heroic struggles against fate may be observed.

generally characteristic of land upon which the redwood grows luxuriantly that the soil is cold and "sour." Where redwoods have grown, it is currently reported that the pea does better as a corrective crop than any other growth, and of fruit trees the prune yields the best return, and does well on lands where redwoods grew. In some districts apple and cherry trees are said to bear well, but apricots and peaches do not succeed. As a general thing, the land is not productive to a high degree, although the rank growth of fern and shrubbery is naturally suggestive of fertility. The writer has ridden through fern growths which were so high that when seated on horseback he could barely reach their tops; growths, therefore, not less than eight feet high, which is high for our ferns. Upon immediately adjacent open land, in nowise differing from those on which the fern and redwood grew (both were bottom lands on Prairie Creek), oat crops were grown. This, the writer ascertained, produced, when made into hay, about one and one half tons to the acre, or, if thrashed, yielded not to exceed twenty-five bushels. This is a low yield, certainly, for sheltered bottom land approximately new. Where production is almost purely for home use, exact figures are not easily obtained, but the yield of one and one half to two tons of hay seems about the average yield derived from redwood clearings all over the belt.

Redwood lands, after being cleared, unless systematically seeded to grass and kept stocked with cattle, grow up in dense underbrush. Varying with locality, these growths differ greatly; but the most characteristic growths are of the Ceanothus family *(C. velutinis, C. lobianus, C. integerrimus, C. crassifolius, and C. divaricatus)*, hazel-brush, spirea, huckleberry, salmonberry, rhododendrons, azaleas, choke-cherry, raspberry, and blackberry bushes; in short, the varied shrubbery of the outer Coast Range. The growth often becomes so thick that the lands are, until cleared, totally unfit for grazing. Where the growth is not so dense, and is kept down by cattle being allowed to run on the same, as is much practiced on the lands immediately skirting the ocean, it seems that the browse, and what there is of grasses to nibble, will support one head of stock to from four to seven acres of land, varying somewhat with the locality and other conditions.

Where, as around Humboldt Bay and Crescent City, the lands cleared have been systematically seeded with grasses, the pasture is fairly good, though the only figure obtainable was where land was stocked with dairy cattle, and here about five acres was assigned to a cow. As to the grasses sown, mesquit grass was formerly in vogue, but now mixtures of several kinds of grasses are preferred—white and red clover, Australian rye grass, and orchard grass all being used.

It should, perhaps, be specially mentioned that by clearing, is simply meant removing the timber, and clearing the brush. The stumps always remain; the network of root filaments remain living permanently, it would seem, and this, if no other cause, would render ordinary redwood land difficult of cultivation; with each year, and after each plowing, a new crop of fine roots having to be overcome. To clear lands, stumps and all, would be an enormous expense, as single stumps often cost as high as seventy dollars to remove them.

2. BENCH-LANDS, FROM FERNDALE SOUTH.

On the elevated benches running south from Salt River to the Mattole, much good land exists suitable for raising crops of grain or fruit. Lands of good quality often fetch forty dollars per acre, and large tracts are being cleared of their brush and timber. The trees (mostly Douglas spruce and white fir and Sitka spruce) are girdled and the brush "slashed" and burnt. The cost of this operation seems to range between five and twelve dollars per acre. The lands being directly fitted for tillage and not pasture only, it is only a matter of time when all the available good land will be cleared of timber.

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3. SHEEP LANDS INSIDE THE REDWOOD BELT.

From the headwaters of Russian River to the Klamath River, and as far east as the south fork of the Trinity, the country is devoted to sheep raising, predominantly; the strip from Spruce Grove to the Mattole River being generally used for the same purpose. Much of the country was originally used for stock, but since the introduction of sheep, the original grasses—bunch grass *(festuca scabrella)* and wild clover and sunflower—have been eaten out, and now an inferior grass, said to have come from Australia *(gastridium Australe)*, and variously known as foxtail, squirreltail, May or June grass, has taken complete possession of the country, to its ruin. The number of sheep which lands are made to carry, varies from two head to five acres, to one sheep to the acre. Overstocking is common, and whereas the ranges when new pretty generally sustain a sheep to each acre, many of the older ranges do not carry more than the figure first stated. The foxtail grass, when the land is heavily stocked, becomes eaten out, as the sheep only nibble the head after the grass commences to ripen, and if heavily stocked a sufficiency of seed does not ripen and fall to propagate a new crop.

Instances have been cited where the grass-covering has been so far reduced that heavy rains have caused such serious wash of the soil that the land was not fitted for further use as a sheep range, even; had become, in fact, worthless.

The coast range formations are naturally subject to wash, and evidence of slides are noticeable on every hand. The overstocking with sheep is one of the worst influences in operation, and much land which would eventually come into requisition for tillage, is in this manner rapidly becoming worthless.

As ranges deterioate under the influence of overstocking, the remedy sought is to render new lands available through burning of brush and girdling of timber. Sheep lands are held at from five dollars up. As the value of land increases, the clearing of timber to render the land fit for grazing will increase, and considerable quantities of timber will be cleared off in this way.

Systematic attempts to improve the quality of sheep lands are not common, the writer knowing but one exception to the general rule. Here the best grass patches are fenced in and guarded, the grass allowed to ripen, when it is threshed and the seed collected. Brush lands (mostly scrub-

oaks), are then fired and the seed sown upon the ash-strewn clearings, the grass used being a species of Australian cheat. The lands thus artificially stocked with grass are said to possess twice the efficiency of the natural open lands.

In connection with the subject of sheep lands, it should be mentioned that the pernicious practices noticed in a great measure affect property still belonging to the Government. There are ranges covering thousands of acres which are controlled (not owned) by sheep men, their holdings simply covering the strategic points of the range, possession of the water sources generally sufficing in itself to attain the desired end. Holding these points, the balance of the range is of no value to any one else, and his herds range undisturbed over public lands. These lands are effectually excluded from settlement, the county and State governments deprived of legitimate sources of revenue, and at the same time valuable public property rapidly going to waste. The timber depredations upon public lands are but matters of minor moment compared with the gradual, but widespread ruin which is being brought about by sheep-ranging.

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4. THE RED-SOIL LANDS OF TRINITY COUNTY.

Trinity County has always found its main resource in mining. Stock raising has probably followed next in order, and agriculture has never been extensively enough practiced to supply the home market with cereals. There is, however, an abundance of good soil in the county, in every way suited for raising crops both of grain and fruit, or which is well adapted for pasture. Its development depends entirely upon a supply of water being rendered available at the proper time of year, and which, at present, is, generally speaking, lacking. The percentage of deeded land is small and the preponderately larger portion still belongs to the public domain.

The yield of agricultural land is low, owing to dryness of the soil at the period just before which crops mature, and it appears that at present the wheat land does not produce over ten to twelve bushels of grain, nor the pasture land more than one ton of hay to the acre, as average figures. Yet these same lands produce three and four crops of alfalfa and good crops of grain when irrigated. Alfalfa does generally well on this land, and if widely sown it might be relied on to produce one crop of hay annually without cultivation, which in itself would be enough to make it pasture land.

The foxtail grass, which has been spoken of in connection with the sheep lands which lie further west, has also spread over Trinity County, and probably one of the only means of eradicating this undesirable grass may prove the alfalfa, the value of which, if lands like those in question could be stocked with it, would be inestimable. Once started, its roots run down so deep in search of moisture that drought does not kill it, while sheep may range upon it without being able to eradicate it and spoil the range, as they do in the case of every other grass when the land is heavily stocked.

The future of these lands is hard to foresee. At present there is a general tendency towards a heavy growth of young trees, which have everywhere made their appearance since the Indian practice of running fires over the land has ceased. It is hardly probable, however, that under the

influence of an increasing population and a growing demand for land, any land will permanently be permitted to remain fallow which can be turned to profit if utilized.*

These lands, however, belong, for a great part, to the class which (in the introductory remarks on the subject of water supply) were considered as being capable of being rendered valuable by water, made available through forest cultivation of higher lying lands. It is, therefore, within the province of Forestry to greatly aid in developing these lands.

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5. THE MOUNTAINOUS LANDS OF THE SISKIYOU AND SALMON RIVER RANGES, AND OF THE NEW RIVER AND TRINITY RANGES.

Under the four preceding headings we have considered, briefly, the general capacity for development of the lands of the Coast Range, north of the Russian River, which, in any probability, will ever be utilized for grazing or agriculture, and which are intrinsically valuable enough to make them centers of settlement.

The rest of the country consists of high barren rocky ridges, which, unless it be for the mineral wealth they may contain, will never be valuable—save a few ridges and plateaus, often several thousand acres in extent, which are said to be covered with waving bunch grass, and which will be valuable as ranges, provided the severity of the climate, or their general inaccessibility, does not permanently debar their use. In this division are to be embraced the Siskiyou Range (which lies north and west of Klamath River); the Salmon River Mountains (dividing the lower Klamath from the Scott River); the New River Range, and the "Trinity Summit" (which divides the main Trinity from the Salmon River), and the Trinity Mountain Range (which divides the waters of the Sacramento River from those flowing into the Eel River and Trinity River, and which forms part of the inner main divide of the Coast Range).

These are rugged complexes of rock and bowlders, barren and denuded dikes of stone, mostly of volcanic formations, predominately serpentine and granite. A more desolate storm-swept district can hardly be imagined, although rough as these mountains are, they are not divest of timber. Nestling in the cañons and on the sheltered slopes of ridges, especially near the river gorges, fine developments of timber will often be found, and save for the most wind-swept, storm-tossed stretches, stunted timber and brush-growths cover the ground, whenever the denuded rock admits of a growth of any kind.†

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*It is, moreover, of great question whether the general growing up of this district in timber, such as is now growing on it, would serve any useful purpose at all. Under the head of "Forest Fires" one phase of the question is considered. As a locality for encouraging a new forest growth, hardly a district of equal area could be selected where a forest might be expected to exert less beneficial influence than here, on account of the peculiar topographical location of most of the land in question. Besides this, the prospect is very remote of this growth ever producing trees of large size, suitable for future reserves of timber. It is ground which, when the conditions have arrived under which it can be utilized, it will be by all means desirable that it be turned into pasture or be farmed.

†The efforts which certain growths will make to adapt themselves to straightened circumstances, finds an interesting exemplification in the brush growth of this district. The tanbark oak, the cañon live oak, the chinquapin, the madroña, all dwarf themselves to low shrubs, and form a matted covering, only a foot or two in height. Among these, dwarf specimens of tamarack and *Pinus tuberculata* appear, and even the sugar pine family developes a stunted variety, but a few feet high. (See Appendix B.)

This district, however, is of interest as containing the sources of the largest rivers in the State, and upon the snows which are here deposited in winter depend the summer flow of the Upper Sacramento, the Klamath, and that of all the large streams which flow directly or mediately to the ocean. These mountains and their timber growths play a leading part in the hydrography of the State.. Any material increase or any material decrease in the forests of this region is liable to be of far-reaching influence. It is, however, from the extreme inaccessibility of these mountains improbable that their timber will ever be cut to any considerable extent. If only properly protected from destruction by fire, they probably will never be seriously encroached upon.

An attempt has been made in the preceding notes to furnish some rough data from which might be drawn, in a general way, correct inferences as to the effect which agricultural development will have upon the country, and to what extent a further reduction of our forest areas may be anticipated from causes other than supplying lumber for market. In connection with our Table F, an estimate was made of what was the amount of wood which might be considered as liable to remain after the redwood had been cut. Certain deductions were at that time made for timber which was known to be in course if destruction, and which it could be predicted with certainty would go with the redwood. These items only referred to the land south of Ferndale, and only covered such timber as stood upon land which at present was known to be valuable enough to pay for clearing. No allowance, however, was made for causes of destruction which were considered remote enough to not admit of practical certainty, such as clearing of grazing lands which, although at present in operation, is not now practiced upon an extensive scale.

It is probable, however, that much of the open timber land will be cleared for farms and ranges in course of time.

FOREST FIRES.

While forest fires have ever been frequent in the Coast Range, and are of daily occurrence during the Summer and Autumn months, it is a matter for congratulation that one seldom meets with large districts whose timber has been totally swept out of existence by fire, as is the case in the forests of the range in Oregon.* To the ordinary causes arising from carelessness, there are added the constant use of fire in clearing land, and the practice of burning the debris of logs, bark, and limbs, caused in logging operations, and which it is claimed is an essential feature of redwood logging.

Redwood logs of size are of such enormous weight that special roads have to be constructed almost for every tree, and clear ground and free scope are essential requisites to successful work in the woods. Where timber stands very thick it is often necessary to work the same ground over twice, and often three times, before being entirely stripped. Each operation produces an enormous accumulation of refuse stuff, which has each time to be cleared away by burning before the logs are removed.

Much sound fallen timber intended for the mill, as a matter of course, is consumed along with the rubbish, though reasonable care is generally exercised to restrict the fires to the ground operated on. Through oversight, however, fires do get out, which often sweep over extensive areas before being checked or naturally dying out. This remark applies more especially to the southern portion of the belt, south of the Humboldt line.

In virgin forests the redwood generally escapes but little damaged; the tanbark oak and spruce, however, being for the most part destroyed.

It is generally conceded that the timber belt in Mendocino is completely swept over by fire about once in every five years—one portion one year, another the season following, but so that in the aggregate but little ground remains which, at the end of the period stated, has not been visited once at least by fire.

In the upper counties, Humboldt and Del Norte, fires, when started, are less prone to spread, owing probably to the moister conditions prevalent, although even here extensive fires have been known in periods of exceptional dryness.

Were the forest growth entirely composed of redwood, the damage might perhaps be confined to suppressing the growth of young trees, to which, however, too much weight should not attach, owing to the remarkable scarcity of small growing redwood trees, save under conditions which are more than exceptional; this peculiar scarcity of young trees among the sequoian forests appearing characteristic both of the redwood and its mammoth cousin.

Great stress has been laid upon the capability of the redwood tree, when sound and once it has attained a certain growth, to pass through ordinary fires undamaged, and attention has been often called to the desirability o redwood lands, as investments, on this score. This is entirely true: as even after sweeping conflagrations, the blackened shafts reclothe them

*For instance, the cedar belt of Port Orford, among which much damage has been done, as also the country between Corvallis and Yaquima Bay, which for a width of twenty miles, and, if I am rightly informed, a length of fifty miles along the coast, is to-day but a forest of burnt spars standing amongst underbrush.

selves with delicate foliage, and vitality continues unimpaired. Were it necessary, many interesting instances could be cited, from personal observation, of its power, even when half eaten through by fire, to make good the loss by local replacement of missing fiber.

These facts admitted, it nevertheless remains certain that the drier portions of the redwood belt are to-day seriously jeopardized by fires, and are annually becoming more so. Paradoxical as the statement may appear, the conviction is expressed that to-day, in portions of the belt in Mendocino County, more sound standing redwood timber is *in course* of destruction by fire than is being cut out by the mills. This being at variance with generally received views, a brief statement of the facts may be permitted.

In the lower belt, other trees, such as tanbark oak and Douglas spruce, are always largely represented, especially on the ridges and near their crests. At these points, moreover, the "tie cullers" have often been at work and much bark has been gathered, the wood of the oak generally remaining on the ground to rot, and the tie splitter—wasteful here as everywhere—utilizing only the best splitting timber; both operations tending to the creation of large quantities of rubbish. Upon hillsides as steep as these, this litter generally before long finds itself lodged against standing trees, and the next fires bring to bear directly upon the standing trunk a heat intense enough to start the process of *undermining* the tree. At first, confined perhaps to penetrating the bark and the wood fibers for a few inches, each succeeding fire, when an accumulation of litter happens to exist, continues the work of undermining, until finally a "doughty" (rotten) streak is struck, when the fire follows the seam and the tree is directly consumed, or until a point is reached when not enough of the section of the tree remains to enable it to withstand the storm winds of Winter, and it falls.

In this portion of the belt, the redwoods are especially firmly rooted, and I have failed to find the first tree turned over by the roots. Not so the other trees, all of which yield easily to heavy winds and are uprooted; their very existence being dependent upon the redwood, which fact can be easily proved by their going when the redwood goes, and that they are always trees of younger growth than the redwoods among which they stand.*

Steep slopes characterize the range, and as the trees disappear before the Winter tempests, their fall is generally guided by adjacent trees against whose trunks they naturally lodge, being ready then to extend the work of constant gradual destruction. The fallen oaks season rapidly, and their wood (our choicest fuel) burns with intense heat; the Douglas spruce, rich in pitch, catches fire easily and burns fiercely, and the fallen redwood, always more or less cracked in falling, and moreover, on these ridges generally showing "doughty" streaks, burns more readily than elsewhere, natural chimneys being created through which fire is rapidly sucked by the draft. If the fallen tree is not consumed by one fire, the consequence is only aggravated, as until finally consumed, it continues with each succeeding fire always to operate upon the same point of the tree, against which it chances to rest.

The process has been sufficiently indicated, and it only remains to point

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*As regards subsequent growths, when the fine timber is gone, the redwoods are not replaced, young spruce only appear sparsely, and as to the reproduction of the tanbark oak, shoots sprout willingly when the roots are left in the ground, but when not cared for do not develop into trees but form a mere brush. The aftergrowth generally may be characterized as brush, raspberry, hazel, huckleberry, and bushes of the ceanothus family rapidly covering the ground and forming dense thickets. This growth is of little value, but is an excellent agent for transmitting flames.

out one other feature. It is generally held that a ridge summit is a natural barrier to fire, which is passed with difficulty, as fires, as the statement runs, "*do not run down hill.*" While this is certainly true as regards forests of standing trees, it ceases to be true of forests in the condition described. During fires, the burning logs are freed from their chance supports and rolling down hill will transmit fires rapidly, which otherwise would not spread, to which fact credible eye-witnesses bear testimony, stating how quickly a fire will cross a ravine and appear on the adjacent ridge, especially where winds facilitate its progress.*

The gradual work of forest destruction, now so little marked as not even to attract general recognition, always has its origin on the higher ground. With each succeeding year the danger will be augmented, and even gullies and cañon bottoms, naturally little visited by fire, may not always remain exempt from ravage.

These remarks apply to the Mendocino belt. After crossing the Humboldt line, moister conditions generally prevail: fires do not spread easily, and foreign timbers are more rare among the redwoods, besides the country being generally smoother and less broken into ridges. Only in the event of continued removal of timber, in course of time creating drier conditions, is a similar danger to this belt from forest fires to be anticipated.

The accumulation of dead wood and debris being the chief agent of destruction, and redwood logging being conducted as a work of extermination, and not likely to be conducted upon other systems, it is believed that the use of fire in the woods in logging, as a means of removing litter and fallen wood, is on the whole beneficial rather than otherwise, and should not be discountenanced in itself: especially when, as now extensively practiced around Humboldt Bay and Crescent City, the clearing by fire is but a preliminary step towards seeding down the cleared ground with grass.†

It has been conceded that fire may be a useful agent, but as it has been pointed out that real danger threatens from its careless use, due precaution should be exacted in the interest of the public good to guard against its misuse. Self-interest generally suffices to insure reasonable care, but fires do get out which, beyond question, if proper inquiry were made, could be traced to pure carelessness. Restrictive legislation, unless supported by proper supervision, is at best an unwieldy tool, and generally useless for lack of enforcement. If, in conjunction with a system of practical forestry, some competent official were at hand duly authorized, firstly, *to aid in checking fires when running*, and afterwards compelled to trace its source and cause, and if resulting from avoidable causes to fasten the responsibility where it belonged, much evil might be avoided. The moral influence exerted by the mere existence of some person upon whom it were incumbent to make proper inquiry, would in itself go far towards making the carelessly disposed more careful, and obviate many fires.

Total prohibition, under legal statute, of all use of fire, in the writer's humble opinion, is unsalutary. In the northern counties, wherever self

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*I have seen ridges several miles in extent where fifty per cent of the standing redwood trees were more or less seriously damaged by fire. The road from Cahto to Westport is a fair instance of this. During the heavy storms of January, 1886, some fifty redwoods were blown across the road from Mendocino City to Ukiah, and between twenty and thirty trees blocked the short stretch between the Low Gap and the Summit (all on about one mile and a half of road).

† It is to be only hoped that this practice may prove capable of wider application, and yield sufficient returns to keep the converted timber lands in a state of practical efficiency. This will probably only prove the case provided the clearings are kept well planted in grass, and sufficiently stocked to prevent the growth of underbrush, which otherwise a year or two is sure to bring forth.

interest suggests the aid of fire—fires have seldom failed to make their accidental appearance even if the law were not flagrantly disregarded. In the Fall months of the year the whole country is hazy with smoke, and the fires are in nowise restricted to private lands. Illicit practices are always the hardest to guard against, especially where partially countenanced by local public sentiment.

It must be remembered that reference is solely made to a heavily timbered district, the natural and proper development of whose resources necessarily implies the destruction of much of its timbered areas; where the climatic conditions are such that much of its timber may be dispensed with without evil consequences following; where the legitimate province of forestry can only extend;—firstly, to perpetuating a supply of valuable timber, adequate to the prospective consumption of the State, with as much margin for outside demand as circumstances will admit of. Secondly, to such corrective measures as may increase the efficiency of certain limited portions of the range, with a view to promote better conditions as regards the distribution of the flowing waters, and aiming to create a supply of water (at present lacking, notwithstanding the immense and excessive annual aqueous deposits), available at high elevations, during short dry periods of the year; the necessity of which will be unquestionably felt when farming of the high lying lands comes into practice. And perhaps, thirdly, to keeping clothed with timber, exposures, which if stripped, might suffer serious denudation.

These three points covered—especially if fairly compensating at higher altitudes for the timber cut in the immediate coast belts (now generally in private hands and beyond State control)—would, it is believed, prevent the probable evil consequences which total extermination of the lower forests can hardly fail to produce, unless remedial measures go hand in hand with the destruction.

Should these suggestions prove, after thorough examination of the whole field, to be well founded, the mere fostering of young growths need only be a matter of solicitude where dense growths are desirable, or where new growths are sought to be established.

As regards the growth of young timber—save only among the heavy redwood forests—the number of young trees which within the last decade or two has sprung up is very great. All the open pine forests, back of the coast, are becoming rapidly stocked with young trees, and much of the open grazing land is rapidly being converted into brush or becoming covered with young saplings—generally Douglas spruce or yellow pine.

The cause of this increase is unquestionably the cessation of the old Indian practice (formerly general) of running fires through the country to keep it open to facilitate hunting, or in driving game before the flames into inclosures set with snares. Under this system about half the ground was burned over each year, in alternate halves; thereby the open lands were kept free of brush and all growth of young trees was checked in the forests. The older, well matured trees, however, suffered very little, as so little undergrowth could mature between one fire and another, that sufficient heat was not developed to hurt older trees, fairly covered with bark and with limbs some distance above the ground. In fact, the Indian system became in some sense a method of forest preservation, and to it we undoubtedly owe the noble forests which were transmitted to our hands.

We may acknowledge this debt to the red man, although his methods may no longer be available in a growing country studded if only sparsely with improvements. The Indian's method may not have been an ideal

one, but it was a better one in his day and generation than our lack of all method is in ours.

The very growth of young trees, left uncared for as at present, must be to those with the good of the forest at heart, a source of concern rather than of satisfaction. With forest fires running—often twenty in a county at one time—and public sentiment dormant to the extent that, save where individual property is at stake, few take the trouble to put out even such incipient fires as might be killed with little effort, there can be no question but that in the growth of young trees *lies the certain guarantee of total extermination* of much of our best forest land, within a few years, unless some effectual methods of protection are inaugurated.

Thirty years ago fires ran yearly through the woods, but forest conflagrations were unknown; the large trees standing sparsely scattered, say five to ten to the acre, were unable to transmit fire, and there was little on the ground to burn. Now thousands of young trees fill the open spaces, and a fire started not only destroys the young trees but the patriarchs of the forest also.

As yet the evil has attained no very serious proportions; but so surely as the young growth is permitted and fires *not kept out entirely* (which will be found a simply impossible matter) fires will occur, which will sweep everything in their path out of existence.

The longer the matter is left to find its own solution the more difficult and expensive of application remedial measures will become.

As a means of protection against fires, one effectual method, and only one, suggests itself—the isolation of such forests as it may be deemed essential to preserve, into blocks of moderate area, separated by strips of waste land, wide enough to insure no spread of fire from one belt to another. This done, the forests may be left to grow up densely, if desired, without fear of extensive damage.

Topographical conditions would generally suggest the location of these waste strips. Ridge summits and cañon bottoms (especially the former) are natural barriers to fire, being only crossed with difficulty by flames, when free of brush and litter. The lines of watershed on spurs are generally sparsely timbered, and could be easily maintained free of undergrowth, even if not denuded of their trees. As regards the strips which have been designated as waste, they might in many cases be capable of sodding or being maintained in grass, producing range and pasture, and for the rest, the authorized use of fire by duly commissioned persons, duly provided with adequate means of checking the spread of flames, might suggest itself as the simplest, cheapest, and most efficient method.

Of course these proposals only have reference to the public lands, private holdings must remain subject to private management, and such forests as now are held in private hands must survive or perish, as the owner elects. In any event, private holdings, when lying within the lines of districts which it might be wished to treat on the basis proposed, will always cause complication. If anything is to be done at all, it is time to do it now, while the Government owns whole districts free from settlers, and consequently, in this respect, at least, need have nothing but the public interest to consider.

A STUDY OF THE INCIPIENT CLIMATIC CHANGE NOTABLE IN HUMBOLDT COUNTY.

THE INFLUENCE OF REDWOOD FORESTS UPON THE FLOW OF STREAMS.

At no point in the Coast Range are so many influences at work stripping wooded lands of their covering as in the vicinity of Humboldt Bay. A perfect cordon of mills extends from Rohnerville, on the Eel River, around the shores of Humboldt Bay to Arcata and up the Mad River to its north fork.

The bottom lands of Eel and Mad Rivers were formerly well timbered with spruce, and heavy growths of underbrush covered them. These have been cleared, as also much agricultural bench-land about Eureka and Ferndale, and much of the logged redwood land converted into pasture. Nowhere has so much energy been focused upon a district contained within equally narrow lines. The acreage cleared in one way and another cannot fall short of about fifty-six thousand acres; or rather, the area within which these operations have been centered, and which was predominantly brush and timber land, will about reach this figure. Compared with the area embraced within the redwood belt, this is but a small acreage, yet signs exist that climatic changes are in progress which may well stand in connection with the clearing of land referred to. That some local influence might have been noticeable would hardly attract wonder, but that the influence should be far-reaching and discernable inside the redwood belt is a matter which would have been received with skepticism were the evidence not unquestionable, the sources from which the statements were volunteered various, and coming from persons residing far enough apart to warrant the observations being general, and not due to chance influences with only a local significance. That the alleged changes have up to the present proved rather salutary than otherwise in nowise affects the case, it being unreasonable to assume that if changes are in progress their march will be an interrupted one.

The facts are stated in the order in which they came to me.

My attention was first directed to a possible climatic change, by the statement of Mr. H. P. Scott, of Orleans Bar (on the Klamath River), to the effect that the seasons were becoming milder, less snow falling in winter, and the frosts having been less severe for a period of several years; as also, that hot days in summer were less numerous, and that cloudy skies had become frequent, whereas they had formerly been uncommon.

This statement was corroborated by Mr. John Lord, who for twenty-seven years past has resided at Arcata and Orleans Bar, dwelling in one place and conducting business in the other. He adduced additional facts, and traced the influence as far as Arcata. Fogs, he asserted, now come down to the Klamath, as far up its course as the mouth of Bluff Creek,* which up to within a few years past had been unknown; besides which, the snowfall upon the Elk Prairie Ridge, between Redwood Creek and the head of Little River and the north fork of Mad River, had for several years past been so much reduced that pack trains now take this divide in winter,

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*Township 10 N., Range 5 E.; Humboldt base and meridian.

although previous to that time a lower trail had been traveled and the ridge only used in summer. Mr. Lord also called my attention to the fact of the decrease of summer fogs at Arcata, which he said were so much reduced in frequency and denseness that for a year or two past crops of potatoes had failed for lack of moisture in the summer months.

The marked decrease of fogs on Humboldt Bay was attested to by numerous persons; and Mr. Comstock (of Flannigan & Brossman's mill) cited the fact that several streams heading in the bench land back of Eureka now carry not one fourth as much water as they did in 1854, when he first arrived. And not only in summer had he noted the decreased flow, but in winter as well.

Years ago, I was informed, navigation on Humboldt Bay was greatly impeded by fogs, which were often so thick that objects were not discernible a ship's-length from the observer, whereas they are now seldom thick enough to cause serious inconvenience to vessels; and that whereas the average fog now lifts by about ten o'clock in the morning, in the days of early settlement the sun seldom made its appearance until well after noon.

Ferndale is still a foggy locality; but many persons have attested to the decrease in the frequency of the heavy dripping fogs, which formerly were almost of daily occurrence, and which wet the ground like heavy rain.

This chain of evidence has been followed through a district, the extreme limits of which are almost seventy miles apart; and to the writer the testimony is convincing. Orleans Bar is thirty miles back from the coast, and thirty-six miles from the nearest point where clearing has been carried on, and is separated from the Mad River by two main divides, which are, respectively, 2,725 and 2,990 feet in height. Verbal testimony, unsupported by instrumental observation, is, however, open to criticism. We have, however, tables of rainfall, reaching back as far as the year 1859–1860, which bear out the statements entirely, and go to show that at Fort Gaston (Hoopa Valley), back of the redwood belt, the rainfall has *constantly increased*, whereas at Humboldt it has *decreased*, and warrant the inference that as timbered lands are cleared the coast climate is liable to become drier, while inland districts *may* derive, in increased rainfall, the benefit of the decrease on the coast. The tables of rainfall are taken from the State Engineer's valuable collection of "Statistical Tables;" and the sources from which these tables were derived are official, being the meteorological records of the War Department and the Lighthouse Board. It is to be only too much regretted that only tables of rainfall are at hand, and not records of temperature and humidity as well, so that the influence on these important points might be traced also.

TABLE G.

Showing the Average Annual Rainfall at Fort Gaston and at Humboldt Bay.

Fort Gaston. Authority: U. S. War Department.		Humboldt Bay.			
		Fort Humboldt. Authority: U. S. War Department.		Humboldt Lighthouse. Authority: U.S. Lighthouse Board.	
Period.	Average Rainfall. Inches.	Period.	Average Rainfall. Inches.	Period.	Average Rainfall. Inches.
1861–62 to 1871–72	45.77	1859–60 to 1862–63	34.95		
1872–73 to 1878–79	47.12	1863–64 to 1865–66	32.05		
1879–80 to 1883–84	52.79			1875–76 to 1877–78	35.49
				1878–79 to 1880–81	31.19
				1881–82 to 1883–84	30.76

Note.—The data from which these figures were compiled will be found in State Engineer Hall's Report for 1886, "Physical Data and Statistics." For Fort Gaston, see pages 46–47, and for Humboldt Bay, see page 185.

The record for Fort Humboldt covers only the years from 1859–60 to 1865–66; that for the Humboldt Lighthouse, the years from 1875–76 to 1883–84. The two points lie so close together, however, and the elevation of the gauges is so nearly the same—50 feet and 53 feet—that the records, although referring to points a few miles apart, may for all practical purposes be considered one record, whereby it is to be observed that the rainfall at the lighthouse would naturally be somewhat greater than that at Fort Humboldt, as the former is, of the two points, the one nearer the ocean.

Referring to the Humboldt Lighthouse record again, the only unmodified records in Mr. Hall's tables are for the following years:

1875–1876	Rainfall 48.76.
1879–1880	Rainfall 36.96.
1880–1881	Rainfall 30.80.
1881–1882	Rainfall 39.98.
1883–1884	Rainfall 24.77.

With one exception—that of 1881–1882—they show a constant decrease in the rainfall.

The rain records of Mendocino County, as shown below in Table H, differ from those of Humboldt inasmuch as, comparing the rainfall of the coast with that of the interior, the coast rainfall shows diminution without corresponding increase at Ukiah.

TABLE H.

Table of Average Annual Rainfall at Ukiah and that on the Coast.

Ukiah. Authority: Geo. McCowan.		Coast Rainfall.			
		Point Arenas. Authority: U. S. Lighthouse Board.		Mendocino. Authority: C. W. Denslow.	
Period.	Average Rainfall.	Period.	Average Rainfall.	Period.	Average Rainfall.
1876–77 to 1877–78	38.77	1875–76 to 1877–78	41.37	1871–72 to 1875–76	53.38
1878–79 to 1880–81	36.19	1878–79 to 1880–81	28.02	1876–77 to 1879–80	61.52
1881–82 to 1883–84	24.69	1881–82 to 1883–84	22.08	1880–81 to 1883–84	37.75

(See page 188—"Physical Data and Statistics.")

These figures are both interesting and suggestive. If a change is noticeable at present, the question suggests itself, what may not be the extent of the influence by the time the redwood has been cleared away entirely?

It may indeed be a matter for congratulation, that the redwood forests of the State are confined to the immediate vicinity of the coast; that Providence has placed them where it did. It is alone due to this fact, that we may hope, in a great measure, to escape the evils which probably would

otherwise follow from denuding so vast an area of forest land under ordinary conditions.

The writer hardly wishes to forecast coming events, yet it certainly is a gratifying fact that back of the redwood belt a well wooded country exists, capable, probably, of holding its own, even after the redwood is gone; that the peculiar location of the redwood lands is such, that owing to their direct exposure to the sea wind and fogs, a deficiency of rainfall, however reduced it may become, is hardly to be anticipated. That, furthermore, no single navigable stream exists, emptying directly into the ocean from the Coast Range, and that, therefore, the evil to be anticipated from all causes is reduced to the absolutest minimum conceivable. It may even transpire that interior districts, reaching back some distance from the coast, may receive an increased deposit of atmospheric waters, and be thereby benefited, if the influences which are apparently at work at present about Fort Gaston and the Klamath River are a gauge of what may be anticipated at other points in the range. The figures in Table H indicate that this may not be always probable, and that the decreased rainfall on the coast may be responded to by equally diminished rainfall in the interior.

What the influence may be upon the head sources of the Sacramento River, if an effect is to be anticipated at all, it may be hard to outline. They may receive additional waters; they may, however, be robbed of a great portion of their present supply—just according to whether the moisture-laden air currents continue to impinge on the high divide of the Trinity and Salmon Rivers, or whether they be forced up so high as to pass over these ranges entirely, in which event it would be difficult to foretell where their waters would be deposited. We have diverged, upon debatable ground, however, and prefer leaving the subject to those fond of abstract speculation.

The influence which forests exert upon springs and watercourses is so generally admitted that it would be almost superfluous to cite special cases. The influence which, among the heavy redwood, is notable, is beyond that to be ordinarily found. Many streams are instanced whose flow seems hardly affected at all by the seasons—which, after heavy rains, show a hardly perceptibly increased flow, which, after considerable periods of dry weather, still continue to carry their normal quantity of water.

THE OPERATION OF EXISTING LAWS UPON OUR FORESTS.

THEIR INFLUENCE UPON THE LUMBER PRODUCING INDUSTRY.

The estimates of the forest resources of the Coast Range, which are to be found in tables A and F, lead to the conclusion that we may reasonably expect, within a century or so, to see the best forests of the State denuded at least, if not entirely swept out of existence.

Merely regarding these as stores of a valuable raw material, consideration of the future wants of the State may suggest the expediency of casting about for means of preserving California from the evil of an exhausted timber supply.

Cheap lumber is a want of the people as a whole, regardless of class or occupation, and, economically considered, our forests are in just such measure as they continue to produce cheap lumber, a premium on all of the industries of the State, in just so much protecting them from outside competition.

To preserve a lasting supply of cheap wood may well be an object of solicitude to those officially charged with caring for the prosperity of the State. Even considerable outlay, if it conserve this purpose, will prove strict *present* economy and not a sacrifice solely for the benefit of coming generations.

Whether it be better policy to guard our present supply—in as much as it still remains public property—or create new resources, is aside from the present question, and is to be determined by considerations other than those referred to.

That the methods by which our forests are being exploited is not an economical one is patent, and a feeling akin to impatience suggests itself when we consider the small amount of the resource which is converted to useful purposes.

In a portion of the report devoted to inquiry into the efficiency of our present methods of operation, however, the conclusion was reached that at least as far as woods possessing a recognized status in the market went, willful waste did not prevail; that other intrinsically valuable woods were being systematically destroyed, however, without any return to the wealth of the community.

Our forests are, in a great measure, going to waste, without compensating benefit to any one, purely because the amount of available raw material is so much in excess of what can be turned to account, and this being the case, overproduction is an unavoidable result.

The class which so far has borne the evil consequences of this unnatural order of things has been mainly the producing class, as is always the case when a market cannot keep pace with the normal powers of production of the industry which supplies it.

It has ever been the beneficent policy of our Government to grant to the settler a home, to open up to development the natural resources of the country as soon as conditions were attained under which these resources could be developed and turned to account in enhancing the general prosperity. The Government considering itself, as it were, the custodian of the public domain, which remained in its hands until a growing demand for

its lands arose, opening them up to settlement. Hereby it has never been doubful that, in addition to the small sum paid to the Government for the lands ceded—if any payment were made at all—it looked to reap the indirect benefits accruing to the State from increased settlement and cultivation and the augmented prosperity of its people. The enactments prescribing the mode of appropriation of land, all bear testimony to this intent; and reservation is always made, or implied, that the appropriation be for the individual benefit of the locator himself, and not for that of third parties.

While acknowledging the principle, it is undeniable that exceptional conditions demand special consideration, and that where permanent settlement, from the very nature of the land appropriated, was not to be reasonably anticipated, other principles should have applied.

It is in the nature of the redwood lands, that for clearing and settlement they were unfit; that even when cleared, their value for agricultural purposes, from many reasons, should be but nominal, and that however great their intrinsic value might be, to the settler with small means, and with only a restricted holding—not to exceed one hundred and sixty acres—they would be of value only to the extent of the price which he might hope to receive from purchasers. And what is true of the redwood, holds good in a great measure for the great majority of other timber lands, although in lesser degree.

Redwood lands are valuable only to those who have the means to convert their timber into marketable products. The expense of milling plant and the thousand and one adjuncts to redwood lumber manufacture, are so great, as to be entirely beyond the means of those seeking a home on small holdings; so great in fact that only the assurance of large timber reserves, guaranteeing a run of a number of years, warrants the erection of a mill at all. The possession in fact, on the part of the mill owners, of several thousand acres of land, at the least, is a primary condition for operation at all. For purposes of actual settlement, a redwood claim is a perfect white elephant to the settler; clear it, he cannot; utilize its timber by his own unaided effort, he cannot; if cleared, the extent of his holding will fail to support him and his family. All through the redwood belt, for miles and miles one may travel, and no signs of present occupation are met with, save here and there on the traveled roads, where the transient travel is such as to warrant a stopping place; nothing but deserted shanties are found, save on natural openings, never covered with redwood timber at all.

Under conditions like these, it was inevitable that the redwood lands should sooner or later be concentrated into the hands of a few.

We judge by the light of subsequent events; the prediction which might have been made has become a reality. The finest forest in existence has, within a decade or two, passed from the hands of the people at large; has passed or is rapidly passing out of the hands of the original appropriators, into the hands of a few, and its destruction within the coming century is certain to transpire. Rightly understood in time, the question arises whether the Government might have not made better terms for itself—have reserved control of the resource and the power to perpetuate the same for ages to come, and have left the industrial class now engaged in stripping the forest better off than it is to-day.

Notwithstanding all restrictions and reservations, redwood lands, since they passed out of the Government's hands, have been matters of bargain and sale; are to-day commodities held for speculative purposes; and as far as actual settlement of the lands themselves, they stand unoccupied, unutilized, as they did twenty years ago.

A resource which it has been estimated is liable to meet the wants or the market for a hundred years to come is still, to a great measure, floating about, finding purchaser after purchaser at enhanced figures, and the price now readily paid for redwood lands varies, according to quality and location of its timber, from three-fold to twenty-fold that which the Government received for the same, and prices are sure to keep on increasing. By the time things have found their level, the value which redwood lands will then represent will necessarily increase the price of lumber materially, and though at present there are perhaps woods enough of other kinds on the public domain sufficient to guarantee the price asked for redwood from becoming excessive for a considerable number of years, we may anticipate marked rises in the comparatively near future. We will then pay in the enhanced price of lumber the penalty for short-sighted policy in the past.

What this penalty will be, will in a very great measure depend upon what care is taken to guard and reserve at least temporary control of the other forests of the State, which still belong to the General Government, and which may be made the subject of future legislative enactments: whether the people deem it advisable to let other forests pass out of their control, until there remain finally nothing left to guard; whether they elect to continue a system under which amounts of timber far in excess of what can be utilized, pass into private and speculative hands, or whether, grown wiser by the light of past experience, a system be inaugurated under which timber lands shall be sold or otherwise thrown open to exploitation, only in such quantities as the legitimate current want demands.

It has been already stated that under conditions like those now pertaining, overproduction was a necessary consequence; and also, that the class which had so far suffered most from an unnatural order of things, was the producing class itself. This is easily seen.

In the first place, as lands center into the hands of new combinations of purchasers, the necessity usually presents itself of these holdings, in order to produce some present return, being made the basis of separate operations. New mills are constantly being built, notwithstanding the fact that the capacity of the present mills is almost double their actual output. Hereby the intensity of competition is augmented. The older establishments are those most liable to suffer, as the newer ones generally have the advantage (for the time being, at least) of virgin ground to work upon, therefore cheaper logging expenses; and moreover, are usually equipped with plant possessing the advantage of modern improvements which older mills may lack.

In the second place, the already existing establishments, to guard themselves against the competition above referred to, naturally seek to accumulate lands for which they at present have no need. By this means, in mere self protection, probably, they are forced to bear the onus of taxation upon lands not needed or utilized, besides the loss of interest upon unproductive capital.

It follows directly that under these conditions, combinations seeking to artificially keep up prices to such extent as may offset the additional expense of manufacture, will necessarily be sought to be brought about, and which, while these combinations last, only shifts the burden upon the consumer; the public suffer.

This order of things is thoroughly artificial and unhealthy, and the cause rests solely in the fact that laws good in themselves, perhaps, were permitted to apply to conditions which they did not fit.

Waste, low efficiency in manufacturing methods, the destruction of valuable timber for which no present market exists, nor for which any market

can be readily created, seeing that the absorbtive power of the present market is fully responded to with supplies of the standard woods; all the objectionable features which force themselves upon the notice of the superficial observer even, these may all be referred to one fundamental cause, and are the necessary result of ill-advised, say rather misapplied, laws.*

In connection with the subject of inadequate legislation, it is considered a duty to call attention to the present State laws regarding the purchase of State school lands, and to point out the course which matters have but too often taken, where this law has found application to timbered lands.

The law permits entry of school lands upon a system of partial or installment payments—twenty per cent of the price of the land sufficing to hold it. At what time subsequent payments are made is to a great measure optional with the purchaser, the State receiving interest in the meantime upon the amounts standing unpaid. When applying to timbered lands, whose value often lies in their timber solely, a fair opportunity for evading the spirit of the law is afforded, as only a fractional payment allows the purchaser to strip the lands of their timber; after which, in default of further payments, they revert to the State. Such cutting of timber on the purchased land is prohibited under statute. Yet there are frequent cases in which the lands have been stripped and no knowledge of the fact being officially known, punishment has not ensued.

My letter of instructions from the Board, calls upon me to report to what extent the cutting of timber upon government land had been practiced. A more specific answer cannot be given than that the practice, on a greater or less scale, has been common. The attention of the Board may, however, be called to the fact that so much latitude exists in regard to the amount of timber upon mineral land, which may be considered admissible under the existing statutes, that it may not always be easy to determine where legitimate use terminates and transgression begins.

A recent enactment of the Commissioner of the Land Office, requiring count being kept, at the mill, of the quantity of lumber cut, and only permitting it to be sold to parties furnishing sworn statements that it is for their own private use and for purposes of home consumption, is, however, a step in the right direction.

The unsalutary influence which our present land laws have exerted upon our forests, and also upon the industrial branches depending upon our forests for their supplies, has been pointed out. Further than this your Engineer does not feel it within the province of his duty, nor within the scope of his ability, to go.

The subject is submitted to the Board with confidence, that when the proper time for decisive action has arrived, it will be prepared to outline a course of legislative enactments commensurate with the needs of the case.

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*In Appendix D, an extract from the report of F. B. Hough to the Commissioner of Agriculture, 1878–1879, is reprinted. The officers of the United States Government have long recognized the inefficiency of our laws as applied to forests, and have not failed to bring the subject to the notice of Congress. Yet little or nothing has been done.

CONCLUDING REMARKS AND RECOMMENDATIONS.

It has been attempted in the preceding report to convey a correct idea of the forests of the Coast Range—their extent and character—as far as they have yet been studied, and to consider the various influences which touch their preservation or destruction. It has also been attempted to trace, as far as possible, the effect which their exploitation has so far had upon physical conditions, and to note any signs of climatic change which may as yet be noticeable.

The desire to place before the Board for its consideration and guidance the facts gathered, as nearly as possible in their original form—as little influenced by the writer's personality as might be—has increased the dimensions of the report beyond what was contemplated, and made it more lengthy than was desired. It was essential, however, that the mode of treatment should be an economic one, which made it necessary to consider many questions at considerable length, in order to arrive at correct conclusions.

Where conclusions had to be drawn for completeness sake, an earnest effort was made to keep to the facts, and to avoid drawing inferences which did not rest on solid foundation, and which, however tempting, might be open to dispute.

It is in the nature of a partial report that no general and wide reaching final conclusions can be drawn, and but few recommendations be made, although several desiderata will suggest themselves in the articles themselves. There are certain lines of action, however, which undoubtedly can be advantageously inaugurated by the Board and which will certainly be productive of good.

To husband the resources which nature has given is a matter of essential importance, and there is perhaps no more effectual way of accomplishing this end than by striving to create a sense of the intrinsic value of our woods. Whatever is not esteemed is either wasted or left fallow and is subject to thoughtless sacrifice upon slight provocation.

An impression prevails that California is utterly deficient in hard woods. This is not the case. Hard woods are not characteristic of the country, but abundant supplies of these exist. Much of our oak is of prime quality; the yew and mountain mahogany, although not very extensively represented, are excellent woods; the madroña and laurel are both valuable, and we have besides pines which are tough and elastic. Of the ash, some is of good quality, although ash is rather a rare wood. Raw material abounds, but the raw material of trees, like all raw material, needs proper treatment to make it valuable, and what proper treatment is, can only be determined by study and experiment. These the agriculturist has neither time nor the necessary facilities for determining.

There is no reason why California should not produce her own supplies of hard woods instead of importing them.

The cause of so much fine wood going to waste is simply that there is no market for it. This can at least be remedied. It is suggested to the Board the desirability of its undertaking the task of introducing our woods into more general use; to determine their value, and to make study of the peculiar modes of treatment which they require, and to disseminate,

as widely as possible, the knowledge acquired. for which purpose bulletins of progress may from time to time be issued. and be either gratuitously distributed to those making application for them. or sold at a price adequate to cover the cost of publication and preparation; that it, besides this, see to the creation of a department ready to supply information when requested of it. Falling entirely within the lines of this idea, there is probably a field for devising methods for utilizing much of the waste product of our woods; probably both the fibers of the redwood bark and the sap-juices of the wood. for example, having value, if the subject were but carefully inquired into.*

If markets are established for our woods, even in outlying districts, care will be taken to guard that which, in course of time. will bring cash returns.

Indiscriminate opposition to all tree-cutting is not the aim of forestry, although there are those who conceive such to be the case, and fail to ascribe to the word any further significance. To *utilize* that which is ripe for utilization is sound policy, and should be encouraged. Such utilization should, however, go hand in hand with methods of replenishment.

The special methods of accomplishing the desired end require careful study. for which time and opportunity has not as yet been allotted. It is unquestionable, however, that a wide field for forestry exists in this State.

The report, unless it has missed its mark, can hardly fail to create the impression that, as regards our forests. matters are in a bad way, and that injudicious legislation is responsible for much of the bad state of affairs. The evil is one which only time will correct:—which better enactments even, would now fail to reach. It is undeniable that something should be done to protect our forests, if only to guard against their exhaustion, danger of which threatens. Statutory legislation—however much it may aid — will not alone prove adequate; our forests need care. It is not without outlay that the evil consequences of a too extensive encroachment upon Nature may be sought to be warded off; time, money. and labor will be required. It is believed, however. that the burden of expense can be so distributed, as to fall lightly upon the community, until a state of equilibrium is brought about, after which little more than a general supervision will be called for.

The opinion is hazarded. that if remedial measures but keep pace with the destruction, the resources of our forests may be freely utilized without evil consequences ensuing. The efficiency of the forests at certain points should be maintained or stimulated. If this be but judiciously carried out, we may hope to realize a compensation in the increased efficiency which may be imparted to lands now of little value.

It is, however, essential, as a basis for intelligent action, to possess a thorough knowledge of the forests of the whole State—a subject which cannot be too carefully studied—and to the accomplishment of which worthy end, this report—with all its shortcomings and defects—hopes to be a first step.

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* Highly conducive to the same end will be found the award of cash premiums and honorary testimonials to those who may successfully devise methods for accomplishing things which the studies of the Board may lead it to consider possible. This will bring the subject to wide consideration, and contribute to the lasting prosperity of the State.

APPENDIX.

APPENDIX A.

"*There is equally good reason for believing that, in the infancy of the art the efficiency was hardly more than 20 per cent.*" *Page 149.*

The Superintendent of one of the largest mills in Mendocino County, where logs were, to a considerable extent, still run in drives, stated that he estimated the average tree to yield from three to four logs—of which the butt log always was a sinker and frequently the second cut also. These are left to dry out on the river banks and are often grown up with bush and forgotten, or are left in the woods if it does not pay to rebuild skidways that perchance have rotted out in the meantime, or often put into the river only partially dried out, go to the bottom before reaching the boom. From all these causes he estimated that not more than one half of the sinkers ever had reached the mill, while water transportation alone was used.

From this cause alone only $\frac{5}{6}$, say $83\frac{1}{3}$ per cent, of the logs in the tree reached the mill (say $\frac{1}{3}$ sinkers; $\frac{1}{2}$ of $\frac{1}{3}=\frac{1}{6}$; $1-\frac{1}{6}=\frac{5}{6}=83\frac{1}{3}$ per cent). Other causes, generally slacker methods, etc., may easily have reduced this 83 per cent, say 10 per cent, making the percentage of logs actually sawed only 73 per cent say, of what, under present methods, would be cut—and the product of lumber sawed proportionately reduced. The present efficiency is 28 per cent, which might indicate the original efficiency not to have exceeded 73 per cent of 28 per cent $=20\frac{1}{2}$ per cent.

"*The extreme limit of efficiency, which he may ever hope to attain, will not exceed 40 per cent.*" *Page 149.*

On page 139 we assumed that 65 per cent of the standing tree reached the mill in form of logs, and stated 63 per cent as the coefficient corresponding to Spaulding's Scale. This would leave 63 per cent of 65 per cent $=40.95$ per cent, which efficiency would only be attained when all the inherent obstacles to economical sawing of redwood were entirely overcome, and logs of redwood sawed with as little waste as pine and spruce. To exceed this maximum, improved appliances in redwood manufacturing can hardly aspire!

APPENDIX B.

THE SUGAR PINE; ITS PECULIAR DEVELOPMENTS IN DEL NORTE COUNTY.

As distinguished by the color and the general appearance of the bark, at least three distinct types of the sugar pine proper exist.

First—The typical sugar pine, with its rich, reddish-brown, even, small-lamellated bark. Of this type noble specimens, six and even eight feet in diameter, may be seen, generally at altitudes hardly less than three thousand feet, and probably extending up to above five thousand feet, although I personally have not seen them growing higher than four thousand three hundred and fifty feet in this part of the range.

These trees are often two hundred feet in height, and sometimes more, with the first limbs one hundred feet from the ground; sixty or seventy feet is, however, still exceptional, and many well grown trees are clothed with branches to within twenty feet of the ground. Thirty to thirty-five feet is, however, the common height.

Of this form of sugar pine, growing well up on the trail between Waldo and the Klamath River (Happy Camp), and on the slope facing the Klamath, trees were observed showing particularly adherent bark, though otherwise not differing from the general appearance of sugar pine bark, save that the clothing of the trunk, due probably to the number of superposed layers, is less smooth and even and is more water-channeled than is usual with the general run of trees. One piece of bark, casually picked up, showed no less than twenty-two superposed scales, and the innermost scales were missing.

Second—The type of sugar pine not uncommon in the upper coast counties, slender of shaft, generally not much over two feet thick, almost black in color of bark, and seldom appearing as a tree larger than one hundred or possibly one hundred and twenty-five feet high. Trees of this kind are especially common on the sunny slopes of the Klamath River. The wood of these trees shows a thicker and more prominently defined sapwood, and the heartwood is less soft than in the brown barked trees.

Third—Trees whose bark can only be compared to hammered silver, the bark being uniformly smooth and showing no water channels, and the scales being only defined to the extent of resembling hammer-marks, the ashy tint being purely silver tinged in the strictest sense (like the dead surface of molten silver newly fractured, or the fine-grained exterior of freshly cast silver bars). Trees of this kind may be found just south of the "Robin's Nest," on the trail from Gasquet's to Waldo, and they are often three feet in diameter and one hundred feet in height, with limbs fifty feet from the ground. The cones are hardly smaller than the average run of sugar pine cones, which generally do not exceed fifteen inches in length. They are, however, strictly of the sugar pine type, and do not resemble those of the *Pinus monticola*. The foliage is that of the ordinary sugar pine, but partakes of the silvery character of the trunk, and is more silver-gray than bluish.

Among woodsmen in this district, the names "silver pine" and "mount-

ain white pine" are commonly spoken of, and they are well distinguished from "sugar pine" in the local phraseology. Of the wood of the former tree, I am indebted to Mr. John Douglas, of Bunker Hill, for the following description, and from comparing notes with him I have little hesitation in connecting it with the trees of the Robin's Nest. Mr. Douglas says: The silver pine works entirely different from ordinary sugar pine; it is exceedingly heavy when cut, and exceedingly light when seasoned; it does not show a white sapwood and creamy tinted heartwood, as does sugar pine in general, but sapwood, heartwood, and core are uniformly white. The wood is very fine grained, but is stringy, tough, and elastic, both when green and when seasoned. It dresses smooth and works beautifully, does not check under exposure to the sun, and sluice boxes which are made of it may be left dry all summer without being affected. Trees are found up to four and four and one half feet in diameter, and they are more apt to be found above the sugar pine than with it.

The most peculiar tree, however, is a dwarfed pine of the sugar pine family, which is found on the wind-swept ridge north of Gasquet's, and which may, when thoroughly studied, even be classed as a variety by itself. Where first seen, it grew among *P. tuberculata* and *P. contorta* as a tree not taller than thirty-five feet in height, but distinctly possessing the whole habit of the sugar pine. The fully matured cones are not longer than four inches in length, two inches and a quarter in width when opened out, and the green cones are bright-purplish crimson. They pend from the tips of the boughs, as do the cones of sugar pine. The bark is grayish white and very persistent, not showing scales at all detachable, although distinctly water marked, and is divided into square or hexagonal checks, the trunk more resembling in general appearance the trunk of *Quercus Garryana* than that of any of the conifers. The foliage is five leafed and very finely leafed, but otherwise not differing from the foliage of sugar pine. From one specimen not four feet high three well-matured red cones were taken (in the second year of their growth), and these measured three inches in length by one inch and one quarter in width, but exactly resembled the ordinary large unopened sugar pine cone, save for the color.

The only reason for supposing that the tree may, when properly studied, deserve classification as a separate variety, and not be only another instance of the disposition of all California trees to show fully matured dwarfed growths, as well as abnormally large specimens, lies in the fact that several miles north of where these dwarf pines were first seen, a large specimen, not less than seventy-five feet in height, but hardly a foot in diameter, and preserving all the distinctive features of the trees described—white checkered bark and red cones pending from the ends of the limbs, included—grows immediately alongside of normal dark barked sugar pines.

The writer, from general points gathered from woodsmen, believes this to be the "mountain white pine," so often spoken of by them, and which is said to frequent the wind-swept rocky summits of the Siskiyou Range, at elevations higher than those which the sugar pine attains to. The wood is said to be very close grained, and very tough.

NOTE.—Whether I am correct or not in applying this description to the silver-barked sugar pines of the Robin's Nest, the description comes from a reliable source and is valuable, especially should it call attention to some valuable pine not as yet referred to the Coast Range.

APPENDIX C.

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To J. H. Goff, Petrolia, Humboldt County.
To Henry Conkling, C.E., Petrolia, Humboldt County.

To James Montgomery, Rio Del, Humboldt County.
To Henderson Taylor, C.E., Hay Fork, Trinity County.
To A. J. Van Matre, Deadwood, Trinity County.
To A. H. Marshall, County Assessor, Humboldt County.
To W. J. Grigsby, Hay Fork, Trinity County.
To W. S. Lowden, C.E., Weaverville, Trinity County.
To Henry Lowden, C.E., Weaverville, Trinity County.
To James Alonzo Matthews, Trinity Centre, Trinity County.
To Charles G. Yale, Scientific and Mining Press.

To all these gentlemen, and to the numerous others who have taken part in furthering the work of the Board of Forestry, thanks are herewith tendered.

To William Hammond Hall, State Engineer, the Board would express the sense of its obligation for the exceptional courtesy of permitting it the use of the valuable State maps, in advance of publication by the department which he heads.

APPENDIX D.

Reprint from the Report of the Hon. F. B. Hough to the Commissioner of Agriculture, 1878-79.

It will be observed that ideas of the conserviency of forests, or the wants of the future, are entirely overlooked in the anxiety to satisfy the current wants of the present time. To one unacquainted with the conditions that actually exist the supplies of timber might be thought inexhaustible in amount and infinite in duration, yet nothing can be more fallacious than this, as the near future must assuredly prove. Without further considering the discussions thus raised, it remains for us to notice the several Acts passed at the second session of the Forty-third Congress, having direct reference to the timber upon the public lands.

In relation to the waste going on upon the public lands in the cutting of the redwood and giant trees in California, the Secretary of the Interior in his annual report for the year ending June 30, 1879, says:

The waste and destruction of the redwood (*Sequoia sempervirens*) and "big trees" (*Sequoia gigantea*) of California have been and continue to be so great as to cause apprehension that these species of trees, the noblest and oldest in the world, will entirely disappear unless some measure be soon taken to preserve at least a portion of them. I am informed that in the more inaccessible sections of the Coast Range in the northern and on the west side of the Sierra Nevada Mountains in the southern section of California, some forests of these trees still remain that may and should be preserved either wholly or, at least, in part. The importance of preserving these species of trees in sufficient quantity to serve to this and coming generations as an illustration of the magnificence of the grandest of primeval forests is so great as to have attracted the attention of men of science in both Europe and America, from some of the most eminent of whom I have received communications on this subject. It is especially desirable that the big trees in the above named localities be preserved, as the "Mariposa Grove," now celebrated for its specimens of that species, is small, and many of the large trees in it are injured by fire.

I would, therefore, recommend that the President be authorized to withdraw from sale or other disposition an area at least equal to two townships on the Coast Range in the northern, and an equal area in the southern part of the State of California, the precise form and location of the tracts to be determined at his discretion.

The Secretary of the Interior, in his report for the year ending June 30, 1879, makes the following statements and suggestions in respect to depredations on the public timber lands:

I deem it my duty again to invite the attention of Congress to the depredations committed on the timber lands of the United States and the necessity of the enactment of laws calculated to arrest the indiscriminate destruction of our forests, especially the mountainous regions of the country. Since my last annual report the only action taken by Congress toward the suppression of timber depredations consisted in the appropriation of $40,000, provided for by the Act of March 3, 1879. Under this appropriation a maximum force of fifteen special timber agents was employed to investigate trespasses in the various public land States and Territories. These agents were from time to time transferred from one field to another, as it was thought that they could best serve the public interests.

The labors of these agents have been fruitful of good results in two directions: First, in collecting testimony for the prosecution of trespassers and for the recovery of the value of timber unlawfully taken from the public lands. It was predicted by many opponents of the policy pursued in this respect by the Department that the cost of the investigations and prosecutions would not be covered by the proceeds, and that therefore the money appropriated and spent for this purpose would in a great part be money thrown away. This prediction has not been justified by results. The sum covered into the Treasury

during the last fiscal year on account of timber depredations was largely in excess of the sum appropriated, and a considerable number of cases is still pending in the Courts awaiting trial, which will, when judgment is obtained, very much increase the amount already recovered. The details are presented in the report of the Commissioner of the General Land Office. The prosecution of depredators on the public timber lands has, therefore, been a well-paying business to the Government.

This, however, is the least important result of the operations of the Department in this respect. Of far greater consequence is the fact that the investigation of trespasses and the prosecution of depredators, carried on with vigor and earnestness, although with very limited means, have created in some of the localities where the depredations had been most extensive, a wholesome respect for the law, and strengthened the desire of good citizens, who have the interests of the country at heart, to see the unlawful destruction of the public timber cease. It is indeed gratifying to observe that the interest in this important question which the measures adopted by the Government have awakened, and the discussions which have followed, have greatly weakened the opposition which existed at the beginning to the policy pursued by this Department. Even in the States and Territories where the timber necessary for domestic and business purposes can be obtained only from the public lands, unless imported from a distance, a healthy public opinion seems to be springing up which recognizes that an indiscriminate destruction of the forests, and especially the denudation of the mountain slopes of the timber growth covering them, must inevitably result in incalculable and irreparable injury to the economical interests of those States and Territories, and become ultimately destructive to the prosperity of their people.

This is an observation which by painful experience has forced itself upon every civilized nation on earth; and it is to be hoped that the American people will become mindful of it while it is yet time to remedy the evil already wrought by the reckless improvidence which has so far prevailed.

While the measures taken by this Department have undoubtedly produced a good effect in many localities, it must be kept in mind that the limited means allowed by Congress permitted only a comparatively small field to be covered by its operations. The greatest danger of a wholesale destruction of our forests, and of the disastrous consequences that destruction will bring after it, exists in those States and Territories where the timber indispensably required for domestic use and local industry must be taken from the public lands, there being no timber lands in private possession, and the public lands being mostly unsurveyed and not subject to purchase or entry.

In my last annual report I discussed the inadequacy of the laws enacted by the last Congress "authorizing the citizens of Colorado, Nevada, and the Territories to fell and remove timber on the public domain for mining and domestic purposes," and providing "for the sale of timber land in the States of California and Oregon and in Washington Territory." The opinion I then ventured to express, that the first of these Acts would be taken advantage of not only by settlers and miners to provide economically for their actual current wants, but by persons who would see in this donation a chance to make money quickly; that it would stimulate a wasteful consumption beyond actual need and lead to wanton destruction, and that the machinery left to this Department to prevent or repress such waste and destruction through the enforcement of rules to be made by the Commissioner of the General Land Office would be found insufficient for that purpose, has already in many places been verified by experience; also the predictions made by the Commissioner of the General Land Office with regard to the effect of the second one of the above named Acts. Referring to what was said about these laws in my last annual report, I repeat my earnest recommendation that they be repealed, and that more adequate legislation be substituted therefor.

It is by no means denied that the people of the above named States and Territories must have timber for their domestic use as well as the requirements of their local industries. Neither is it insisted upon that the timber so required should be imported from a distance, so that the forests in those States and Territories might remain intact. This would be unreasonable. But it is deemed necessary that a law be enacted providing that the people may lawfully acquire the timber required for their domestic use and their local industries from the public lands under such regulations as will prevent the indiscriminate and irreparable destruction of forests, with its train of disastrous consequences. It is thought that this end will be reached by authorizing the Government to sell timber from the public lands principally valuable for the timber thereon, without conveying the fee, and to conduct such sales by Government officers under such instructions from this Department as will be calculated to prevent the denudation of large tracts, especially in those mountain regions where forests once destroyed will not reproduce themselves. I have no doubt that under such a law, well considered in its provisions, the people of those States and Territories would be enabled to obtain all the timber they need for domestic as well as industrial purposes at reasonable rates, and that at the same time the cutting of timber can be so regulated as to afford sufficient protection to the existence and reproduction of the forests, which is so indispensable to the future prosperity of those regions. I venture to express the opinion that the enactment of such a law has become a pressing necessity, and cannot much longer be delayed without great and irreparable injury to one of the most vital interests of the people. I therefore again commend to the consideration of Congress the bill introduced as Senate Bill No. 609 in the last Congress.

The subject of the destruction of forests by fire also calls for early and earnest attention. In most, if not all, of the States where timber lands are in private possession, the

setting of fires in them is made a highly penal offense by statute. But there is no law of the United States providing specifically for the punishment of such offenses when committed on the public lands. It is a matter of experience that such fires on the public lands of the Western States and Territories are sometimes set by Indians, but in a majority of cases by hunters, mining prospectors, and tourists, who negligently leave their camp-fires burning when moving from place to place, as well as by persons who deliberately set timber on fire for the purpose of deadening and thus preparing it for particular use. It is said that larger areas of timber land are devastated by such fires than by all other kinds of depredation, and this is probably true. I therefore repeat the recommendation made in my first annual report, that a law be enacted prescribing a severe penalty for the willful or negligent setting of fires upon the public lands of the United States, and also for the recovery of all damages thereby sustained. It may in many cases be difficult to obtain the testimony necessary for the conviction of persons guilty of this offense; but if the law is successfully enforced only in some instances, it will serve to direct general attention to the danger to which any one who willfully or negligently sets fire to public timber exposes himself, and thus to make many persons, who so far have given no thought to the possible consequences of their negligence or recklessness, more careful in the future.

I would also repeat the recommendation made in former reports that the President be authorized to appoint a Commission, composed of qualified persons, to study the laws and practices adopted in other countries for the preservation and cultivation of forests, and to report to Congress a plan for the same object, applicable to our circumstances. The time is fast approaching when forest culture will be to the people of the United States as important a question as it is in older countries; and then it will be a subject of painful wonder to thinking men, how it could have been so long neglected.

ARBOR DAY BILL,

TO BE OFFERED FOR ADOPTION AT THE SESSION OF THE LEGISLATURE OF 1887.

An Act to Encourage Tree Planting Within the State of California.

The People of the State of California, represented in Senate and Assembly, do enact as follows:

I.

The last Saturday of each month of January hereafter following is hereby declared to be a legal holiday, and shall be known and observed as "Arbor Day," and shall be devoted to the planting of trees.

II.

The State Board of Forestry is hereby authorized and empowered, for the purpose of encouraging individual planters of trees in forest form, to offer, in behalf of the State of California, such reward or rewards, not exceeding the aggregate sum of one thousand dollars ($1,000), annually, as the said Board may deem expedient, such rewards to be bestowed in the order of merit upon such planters of trees in forest form within the State as the said Board may find most deserving of distinction therefor; but no reward shall be bestowed for trees now already planted in forest form, and no reward shall be bestowed more than once upon any same forest of trees.

III.

For the purpose of carrying out the provisions of the section last preceding, the annual sum of one thousand dollars ($1,000) for each year is hereby appropriated, and the Chairman of the said Board shall draw on the Auditor of the State his warrant, countersigned by the Secretary of said Board, payable to the order of the person upon whom any reward by this section provided for may be bestowed, and upon the receipt thereof, duly indorsed, the Auditor shall draw his warrant on the Treasurer of the State for the amount therein named, and the same shall be paid by said Treasurer out of the one thousand dollar ($1,000) appropriation by this section made.

IV.

This Act shall take effect and be in force from and after its passage.

TREE CULTURE EXPERIMENTS

MADE BY THE

SOUTHERN PACIFIC RAILROAD COMPANY.

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TREE CULTURE EXPERIMENTS.

Made by the Southern Pacific Railroad Company.

The following letters relating to the experiments of the Southern Pacific Railroad Company will be found of interest, and more especially to those who have undertaken the culture of the different varieties of eucalyptus:

Southern Pacific Company, San Francisco,
November 5, 1886.

Abbot Kinney, Esq., *Chairman State Board of Forestry, 42 Nevada Block, City:*

Dear Sir: Your favor of the eighteenth ult., to Mr. Towne, having been referred to me, I inclose you herewith a report from Mr. John R. Scupham, made May 20, 1885, at which time the company practically discontinued its tree culture experiments.

I think you will find embodied in this report all the information that we are able to furnish on this subject; however, if you can suggest any other general information that you think we can supply, or should you desire more specific knowledge about result of tree culture in any particular locality, we shall be happy to furnish same if possible, or put you in communication with any of our agents who may be able to furnish data of value to your Board.

Yours respectfully,

W. G. CURTIS,
Superintendent of Track.

Mr. W. G. Curtis, *Superintendent of Track, Southern Pacific Company!*

Dear Sir: I beg leave to submit to you herewith a report in regard to tree planting along the line of railroad, and on the property belonging to this company.

In the year 1877 it was determined by the Directors to try the experiment of tree culture through the various sections of the country traversed by the lines of railroad controlled by the company, with the following objects in view:

First—To demonstrate the value and capability of the land.

Second—To test the value of certain woods for railroad purposes, and the practicability of their economic cultivation.

Third—To remove the sterile and forbidding appearance of the stations and section houses in the treeless plains and valleys, by surrounding them with fruit and shade trees.

It was determined to carry this work on under the Superintendent of Track, and it was specially put in my charge, with instructions to make the current expenses as small as possible.

My first effort was directed toward the culture of the rapid growing varieties of the eucalyptus on the margin of the right of way, where it was available, with a view to utilize the growth to test the economic value of the wood.

For this purpose some thousands of tree plants were purchased in the nurseries of Oakland and Haywards, and planted along the right of way of the lines running through Alameda County, California. The total number planted in this way was about forty-four thousand trees, mostly plants of the *E. globulus*, but including also a good number of the *E. amygdalina* and *E. rostrata*.

To anticipate this experiment as a test of the wood, about a thousand telegraph poles were procured, of the young growth of the *E. globulus*, or blue gum, and also some two hundred and twenty-eight fair-sized railroad ties of the same variety of timber. The telegraph poles were turned over to the department under Mr. Vandenberg, and were placed by him in the line along the San Pablo and Tulare Railroad. The railroad ties were placed in the track near Rose Creek, Nevada, on the Truckee Division, Central Pacific Railroad. This point was selected because it was found that there the destruction of ties by rot was extremely rapid.

Mr. Vandenburg's report of the test of the eucalyptus for telegraph poles showed that while they were strong and tough, and bore up the wire well under all circumstances, yet they did not last well, as they were inclined to rot in the ground; and just at the surface of the ground they were attacked by the larvæ of some large beetle.

The eucalyptus ties placed in the sandy soil of Rose Creek very quickly showed a tendency to check or crack in an extraordinary manner, so that in some cases it was found difficult to find a place on them suitable to hold spike; otherwise the ties were very strong, and lasted well.

After being four years in the track, Roadmaster Browning reported "no signs of decay." After being six years in the track, slight signs of rot were reported, and two out of two hundred and twenty-six were removed for being split.

After seven years in the track, two inches of rot was reported, and seventy-three were taken out of track. This would show the blue gum ties comparing in durability with best yellow pine, which is our best second class tie.

The trees planted along the right of way in Alameda County showed great thriftiness of growth, and in a few years demonstrated that wood could be produced in this way with surprising rapidity. In four years some of the trees had reached a height of twenty-four to twenty-six feet, and a diameter of eight to ten inches.

At this point it was deemed expedient to terminate the experiment, and the trees were cut down and used for engine wood.

In 1877 Mr. C. P. Huntington sent out a box of catalpa seed (*Catalpa bignonides*) with a strong recommendation that it be tested with a view to cultivate a plantation for tie timber. The wood of the catalpa is coarse grained and light, but it has the reputation of being "the most durable under ground of all timber." Cases are quoted of its lasting buried in the ground eighty years and upward, without showing signs of rot. (Ohio Agricultural Reports, 1871.) The Goshen branch, just built at this time, passed through a treeless region, where the land was very moist and very fertile, hence it was deemed a good place for the catalpa experiment, and a parcel of land, fifteen acres in extent, was selected for that purpose in the Town of Hanford, Tulare County, California.

This tract was planted with catalpa seed raised from the seed sent out by Mr. Huntington. The trees were set out eight feet apart, east and west, and ten feet apart, north and south. They throve remarkably well, growing almost as rapidly as the eucalyptus trees about San Francisco Bay; but in the course of time the company received what was thought to be a very advantageous offer for this land, and it was sold.

Though the experimental grove was taken out of our hands, it yet continues to flourish, and I learn from the report of the company's agent that these trees, which are now seven years old, have attained a height of from fifty to sixty feet, and are from eight to twelve inches in diameter. They have now, therefore, reached a size when some of the trees might be cut for ties. They were planted three hundred and twenty-six to the acre. If one fourth of these could be cut for ties, and, by splitting through the center as is suggested, four ties be made from a tree, this ground may be considered to already bear a very valuable crop.

It was considered that the most important work on hand was that of planting out about the station and section houses.

To have a cheap and convenient source from which to procure tree plants, it was determined to establish two nurseries, one in the northern and the other in the southern portion of California.

For the first a block of land belonging to the company was selected in the town of Chico. For the second locality we took a portion of the right of way, situated between Sumner Station and the Kern River.

The strong clay soil of Chico was relied on to produce the plants of the catalpa, locust, walnut, poplar, and certain fruit trees; while the sandy soil and hot climate of Kern River Valley was expected to produce the different varieties of eucalyptus, acacia, and pepper trees, and certain trees of arid habitat.

From these sources we soon had an abundant supply of tree plants.

In the Spring of 1877 the whole of the country east of Tulare Lake and south of the present town of Tulare, was an unoccupied waste, used only sparingly for pasture. With a view of demonstrating that this treeless waste could be made fit for homes, a half section of land was selected in the midst of this area, at a point just south of Tipton. This was inclosed with a fence, and planted with eucalyptus and acacia trees, and for their maintenance, an effort was made to get an artesian well, which resulted successfully. A good flow of water was obtained at a depth of four hundred and eight feet.

Stimulated with this water the tree plants grew fairly well and soon presented the appearance of a grove. The example was followed by settlers who bought land, and soon were sinking artesian wells and making homes throughout this section; showing that one object of the experiment had been accomplished.

We soon found, however, that the blue gum was too susceptible to frost to thrive permanently at Tipton. Each Winter biting, frosty air pours down from the mountains out of the cañon of Deer Creek, onto this particular tract, thus killing the tender blue gums in spite of their strong Summer's growth. An experiment was also tried at Delano. This station at that time was a sheep-shearing camp, and from its situation greatly troubled by malaria, so that at times all the inhabitants were stricken with fever and ague.

With a view of testing the efficacy of the eucalyptus trees as a preventive, four rows of the plants of the *E. globulus* were planted along the railroad track, which was so situated as to form a barrier between the town and Tulare Lake. These trees manifested an extraordinary growth.

The second year they were from twelve to fourteen feet high. From that time on cases of malarial disease rarely originated in the town. Before that the section men stationed

there usually went to the hospital after two months residence. Now it appears as healthy as any other station on the road.

The trees at Delano still flourish with unexampled vigor, enduring frosts that have cut down most trees of their kind in that section.

For this unusual hardiness there appears to be no special reason, and we must conclude that situations that are recognized as malarial are particularly favorable for the eucalypti.

The nurseries at Chico and Sumner (Kern River) furnished tree plants, and each Spring, during the season adapted to planting, they were distributed along the lines of railroad, and planted about the station and section houses.

In some localities, notably in Nevada, great difficulty was found in making the tree live. This resulted partly from the altitude and severe climate, and partly from selecting trees ill adapted to the locality.

It is true we knew that cottonwood and quaking asp, and the like, would flourish at the most difficult points, but it was deemed worth while to try what could be done with more desirable species, and with fruit trees.

In this way it was not by once planting, but by many times planting, that the stations in the treeless wastes were gradually embowered.

Often, even after trees were well started, the carelessness of an employé would allow them to die off again.

The situation at Kern River was found to be excellent for a nursery, but for the sake of economy it was abandoned in favor of Tipton, where the plantation and nursery could be consolidated. Most of the trees planted out along the Southern Pacific, as far east as El Paso, were raised in this nursery from the seed. In extending the tree planting through Arizona and New Mexico, an unexpected difficulty was encountered. We had looked for trouble from the heat and drought, but we found the most serious to arise from frost.

We never expected to find, as our meteorological observations now show, a minimum temperature of eight degrees and ten degrees for stations in Arizona. In consequence of this lack of sufficient data, the trees sent to that section for several seasons have been frost killed, as the first experience of this kind was thought unusual and exceptional and the same kinds were tried again. I believe I can now report that the present stations throughout California are sufficiently well supplied with living trees, so that, with reasonable care, the beauty and advantage to be derived from them will be constantly on the increase.

In Arizona and New Mexico, with our present experience, something more might be done. Mr. Muir, Division Superintendent, is especially anxious to have another effort made with the stations from Tucson east. Even should this be determined on, it will no longer be necessary to continue our nurseries at Chico and Tipton.

Yours respectfully,

J. R. SCUPHAM.

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